

THE
MAGAZINE OF SCIENCE,
AND
SCHOOL OF ARTS:

INTENDED TO ILLUSTRATE THE MOST USEFUL, NOVEL, AND INTERESTING PARTS
OF
NATURAL HISTORY AND EXPERIMENTAL PHILOSOPHY,
ARTISTICAL PROCESSES,
ORNAMENTAL MANUFACTURES, AND THE ARTS OF LIFE.

EDITED BY
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ART OF MODELLING WAXEN FLOWERS, ETC., ETC.



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Ms. no. 22
C. F. Andrew
Cambridge
April 13-1871

P R E F A C E

THE conclusion of another year finds us occupying the same post of usefulness as at its commencement; while the same energy and care has been taken to cater for the amusement and instruction of our friends throughout this our fourth volume, in hopes of making it a fit companion to its predecessors.

The observations which we were bound to make on a former occasion upon the paucity of scientific novelties are equally applicable now. In fact, the learned world seem to be resting on their former laurels: it is to be hoped not idly, but with the well-grounded expectation of bursting forth with important discoveries at a quickly-approaching period; we trust sincerely that this is the case. Let us not forget, however, the labors of Mr. Moser on Latent Light, and of Mr. Hunt on Thermography, whose experiments and reasonings we have duly noted, and which bid fair to explain phenomena otherwise unintelligible. The various improvements on the Daguerreotype, and on Galvanic Depositions, are full of interest.

Notwithstanding this absence of scientific invention, we think it will be admitted that we have kept up the spirit of our little work with uniformity and utility; recording the novelties that the season furnished, explaining the known laws and principles of science and natural history, describing interesting apparatus and machinery, and as fully as circumstances would allow, giving an account of little-known, but useful processes in arts and manufactures. During the four years that we have continued this course we have never, (except in one or two instances by mere accident,) inserted the same article twice, nor even treated of the same subject twice, unless we had fresh and important additional matter to communicate; and this we would particularly allude to, because herein our exertion has most shown itself, and we can assure our friends that to find and to write fresh matter for eight large pages, each successive week for four years, has been no easy task. It is this method which, perhaps, has made our work so patronized, and which renders the sale of the back parts, even those longest published, so great; our recently-acquired friends being aware that in purchasing former volumes they still obtain different information, although all of the same general character, and our old friends relying upon something fresh in each recurring number.

PREFACE.

Correspondents we have endeavoured to answer at all times when it was possible to do so. Yet let it be remembered, that to give satisfaction to correspondents is a most difficult task, especially relative to those letters requiring the secrets of trade, for these an editor cannot always procure; and others asking trivialities, such as any introductory book will explain, and which he cannot find time to answer. Very many questions solicit replies by post—we have indulged numerous strangers by writing to them; but this system we are obliged to discontinue, for independently of the time occupied, and paper and often postage expended, it has too often led to a second letter from the parties, commencing thus: "As you were so kind as to answer by post before, I will intrude upon you a few more difficulties, &c. &c."—Upon this we need make no comment. Friends who have contributed papers we are grateful to, and beg that they will receive our thanks. We at all times solicit accounts of inventions and discoveries of a useful character, and shall be careful to give them our best consideration.

After so long a trial of our Magazine we are sure that our friends will have reliance upon the future; that there will be laid before them from time to time the newest and the best information that is procurable; and that a degree of freshness and vigor may be instilled into the next new volume we intend to resign the editorship for a short season, that we may renovate our own mind, and that our readers may be enabled to benefit by the services of a gentleman, well known in the literary world, and who is by his activity and experience well able to give the same satisfaction, to inspire the same confidence, and to cherish the same good feeling which we have always aimed at, and we hope always accomplished.

G. FRANCIS, FLS.

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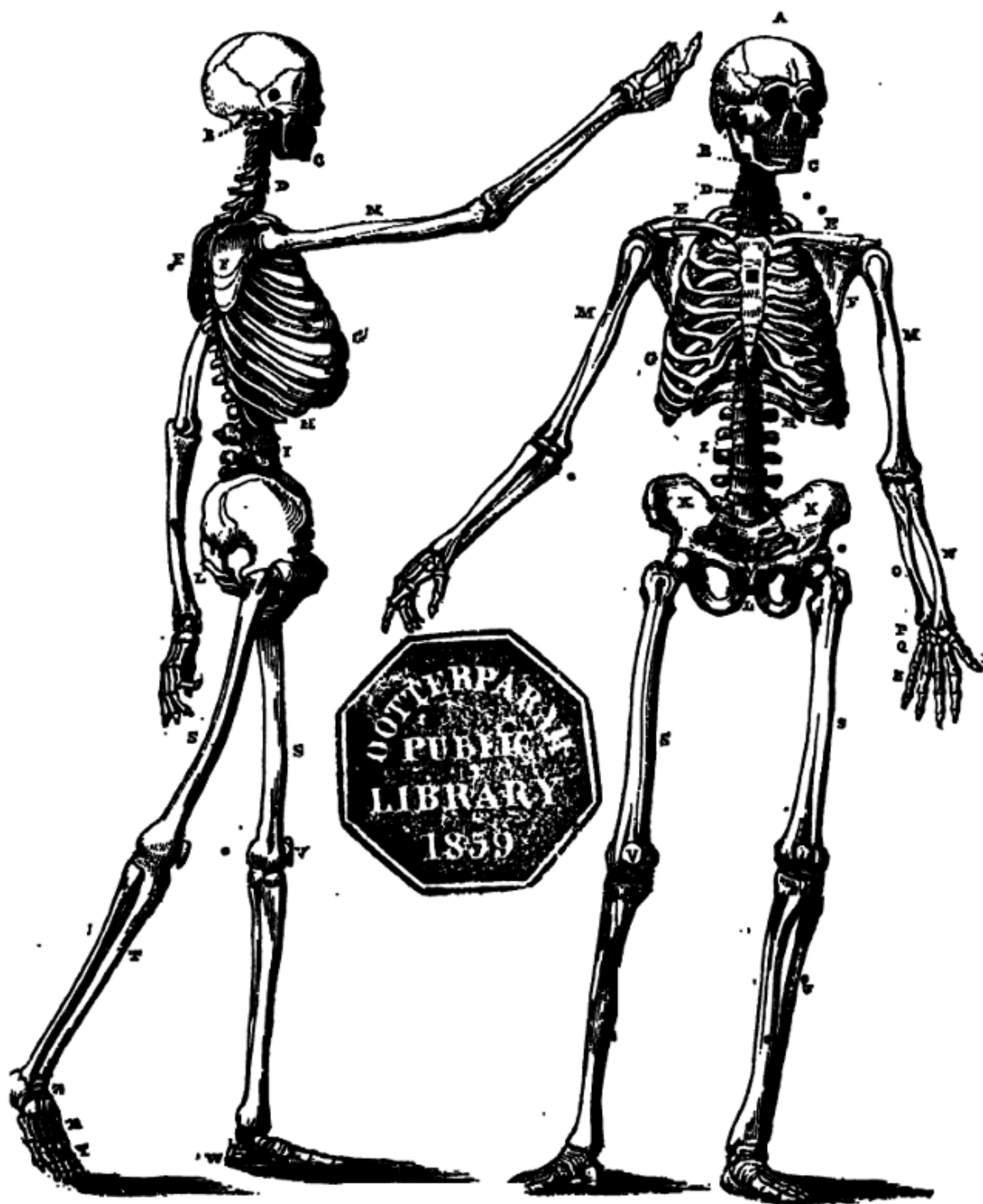
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THE HUMAN SKELETON.

THE HUMAN SKELETON.

We have never professed to treat upon subjects of anatomy or medicine, such being contrary to the legitimate objects of a "Magazine of Science and Art." A short paper however on human osteology cannot be uninteresting to most of our readers,—especially when they remember the human skeleton forms one of the most important bases of comparative anatomy and geology. For, as Cruveilhier remarks, "By the study of bones the anatomist has been enabled to determine genera and species, no longer existing on the face of the globe, and to give as it were new life to these old and disjointed relics of the antediluvian animal kingdom. Thus the fossil bones, deposited in an invariable order of superposition in the crust of the earth, have been transformed into monuments more authentic than historical records."

General view of the skeleton.—The bones form a system or whole of which the different parts are contiguous, and united to each other. The only exceptions are the *os hyoides*, or bone of the tongue, and the *patella*, or knee-cap; these are not united in the human subject with other bones. The assemblage of the bones constitutes the skeleton,—it is called a *natural* skeleton when its different parts are connected by their own ligaments; an *artificial* skeleton on the other hand is one of which the bones are joined together by artificial connexions, such as metallic wires, &c.

The result of this union is a symmetrical and regular structure, essentially composed of a central column, denominated the *vertebral column* or *spine*, which terminates above in a considerable enlargement, called the *cranium*, (skull), and below in certain immovably united vertebræ, which constitute the *sacrum* and *coccyx*. To this column the following appendages are attached: First,—in front of and below the cranium is a complicated osseous structure, the *face*, divided into the *superior* and *inferior maxillæ*, commonly known as the upper and lower jaw. On each side are twelve bony arches, flexible, elastic, and curved, called the *ribs*, which are united in front to another column or plate, the *sternum* or breast bone. These parts taken together form the *thorax*. At the lower part of the spine are two large bones, called *ossa innominata*, or in ordinary language, *hip bones*. These form between them a large cavity called the *pelvis*. Four prolongations, called limbs or extremities arise; two from the upper part of the trunk, called, therefore, the *thoracic extremities*, including the arms and hands, and two extremities joined to the pelvis, therefore called *pelvic* or *abdominal extremities*; they include the thighs, legs, and feet.

Authors do not agree in the number of the bones in the human skeleton, some including the teeth, others excluding these—which in the adult are thirty-two in number. There are also four bones belonging to each ear beneath the temporal bones, and which are not usually exhibited. The whole number is therefore as follows, including the above:

Spine, or vertebral column.....	26
Cranium	8
Face.....	14
<i>Os hyoides</i>	1
Ribs and sternum.....	25
Superior extremities each 32, namely:—shoulder, arm fore-arm and hand.....	64
Inferior extremity each 30, including pelvis, thigh, leg and foot. &c.....	60
Teeth 32, bones of the ears 8	40

For the name and position of each particular bone, we refer to the cut and also to the following table:—

A, cranium. B, extremity of the spine. C, maxilla inferior the lower jaw. D, cervical vertebræ. 7 in number. E E, clavicle or collar bones. F F, scapula, or blade bones. G, ribs united by the sternum. H, false ribs. I, dorsal vertebræ and lumbar vertebræ; the former 12, the latter 5 in number. K K, os ilium. L, os coccygis or coccyx. M, humerus. N, radius. O, ulna. P, carpus. Q, metacarpal bones. R, fingers and thumb. S, os femoris, the thigh bone. T, tibia. U, fibula. V, patella, or knee-cap. W, calcus, the heel. X, astragalus, the instep. Y, metatarsi, at the extremity of which as the *ossa digitorum pedis*, are the bones of the toes. That the bones of the head and of the face shall be better understood, we have annexed a larger cut of those parts, and to which alone the following letters have reference:—



A, *os frontis*, the frontal bone. B, *os parietalis*, parietal bone. C, *os occipitis*, occipital bone. D, *os temporis*, temporal bone, a mastoid process of the temporal bone. E, *os sphenoides*, sphenoid bone. F, *os malaris*, cheek bone. G, superior maxillary or upper jaw bone. H, nasal or nose bone. I, *os unguis*, or lacrimal bone. J, inferior maxillary or lower jaw.

THE BUDE LIGHT.

MR. GURNEY'S Bude light in the House of Commons has been found very economical. The expense of wax, the old method of lighting, amounted during the session to 1,300*l.*, and the nightly cost for the House of Commons alone was 5*l.* Under Mr. Gurney's contract, the charge per annum for lighting the House is 100*l.*; and that for the committee-rooms, library, &c. 130*l.* The nightly cost of the House of Commons itself is only 12*s.* Thus, by Mr. Gurney's new method, there accrues to the country an annual saving of 1,030*l.*

The Bude light has also been successfully introduced in Christ Church, Albany Street, Regent's Park; where a more perfect illumination is produced by two lustres than by seventy-two Argand burners. The perfect ventilation of the church is likewise effected by flues ascending from these lustres.

through the ceiling, into the open air, which carry off all heat, noxious products of combustion, and air vitiated by respiration. These advantages are peculiar to a light of this power, as lights of less power must be placed at such a distance from the ceiling, in order to illuminate the lower parts of the building, as would render it impracticable to carry ventilating flues from each burner.

CHEMICAL EQUIVALENTS.

CHEMICAL equivalent is a term employed in chemical philosophy, to express the system of definite ratios, in which the corpuscular subjects of this science reciprocally combine, referred to a common standard, reckoned unity. The principal facts relating to chemical combinations require to be stated, in order to render the present subject intelligible.

In the first place, leaving out of view the combinations of liquids with each other, and the common cases of solution in water and alcohol, the first law relating to the combination of substances is, that the composition of bodies is fixed and invariable; or, in other words, a compound substance, so long as it retains its characteristic properties, always consists of the same elements, united together in the same proportion. Sulphuric acid, for example, is always composed of sulphur and oxygen, in the ratio of sixteen parts, by weight, of the former, to twenty-four of the latter; no other elements can form it, nor can its own elements form it in any other proportion. Sulphate of barytes, in like manner, is always composed of forty parts of sulphuric acid and seventy-eight of barytes. If sulphuric acid and barytes should enter into combination in any other proportion, some new compound, different from sulphate of barytes, would be formed.

The second law relating to this subject, is, that, when one body combines with another in different proportions, the larger proportion of one of the ingredients has a simple arithmetical ratio to the smaller proportion;—the second quantity being a simple multiple of the first; and if there is a third or fourth proportion, the same ratio continues between them. The combinations of the two substances, which in their gaseous state, form, by their mixture, the atmosphere,—oxygen and nitrogen,—unite in five different proportions, and form a good illustration of this law, these proportions having to each other the simple ratio of 1, 2, 3, 4, 5.

	Nitrogen.	Oxygen.
Nitrous oxide consists of.....	14	8
Nitric oxide, ...	14	16
Hypo-nitrous acid, ...	14	21
Nitrous acid, ...	14	32
Nitric acid, ...	14	40

To give an example from the salts,—the bicarbonate of potash, contains twice as much carbonic acid as the carbonate; and the oxalic acid of the three oxalates of potash is in the ratio of 1, 2, and 4. This law is often called the law of multiples or of combination in multiple proportion. It has been established only by comparatively recent investigations, but the most rigid researches have abundantly evinced that it is a well-founded law.

The third law of combination is no less remarkable than the preceding, and is intimately connected with it. Water and hypo-sulphurous acid may be adduced for its illustration. The former is composed of eight oxygen to one hydrogen; the latter of eight oxygen to sixteen sulphur. Now, the well-known substance sulphureted hydrogen, is

constituted of one hydrogen to sixteen sulphur; that is, the quantities of hydrogen and of sulphur, which combine with the same quantity of oxygen, combine with one another. Again, forty parts of selenium, with eight of oxygen form the oxide of selenium, and with one of hydrogen, seleniureted hydrogen; thirty-six parts of chlorine, with eight of oxygen, constitute the oxide of chlorine, and with one of hydrogen, form muriatic acid gas; sixteen parts of sulphur combine with thirty-six of chlorine to form the chloride of sulphur.

It is manifest, from these examples, that bodies unite according to proportional numbers; and hence has arisen the use of certain terms, as, *proportion*, *combining proportion*, or *equivalent*, to express them. Thus the combining proportions of the substances just alluded to are,—

Hydrogen	1
Oxygen	8
Sulphur	16
Chlorine	36
Selenium	40

When one body combines with another in more than one proportion, then the law of multiples, already explained, comes into action. Thus,

Hypo sulphurous acid is composed of 16 or 1 pr. of sulphur, + 8 or 1 pr. of oxygen. Sulphurous acid, 6 or 1 pr. of sulphur, + 16 or 2 pr. of oxygen. Sulphuric acid, 16 or 1 pr. of sulphur + 24 or 3 pr. of oxygen.

The most usual combination is 1 proportion of one body either with 1 or with 2 proportions of another. Combinations of 1 to 3, or 1 to 4, are very uncommon, unless the more simple compounds likewise exist.

But this law does not apply to elementary substances only, since compound bodies have their combining proportions, which may likewise be expressed in numbers. Thus, since water is composed of one proportion, or 8 of oxygen, and one proportion, or 1 of hydrogen, its combining proportion is 9. The proportion of sulphuric acid is 40, because it is a compound of one proportion, or 16 of sulphur, and three proportions, or 24 of oxygen; and, in like manner, the combining proportion of muriatic acid is 37, because it is a compound of one proportion, or 36 of chlorine, and one proportion, or 1 of hydrogen. The proportional number of potassium is 40, and, as that quantity combines with 8 of oxygen to form potash, the combining proportion of potash is 48. Now, when these compounds unite, one proportion of the one combines with one, two, three, or more proportions of the other, precisely as the simple substances do. The hydrate of potash, for example, is constituted of 48 potash and 9 of water, and its combining proportion is, consequently, 48 + 9, or 57. The sulphate of potash is composed of 40 sulphuric acid + 48 potash. The combining proportion of this salt is, therefore, 88. The muriate of the same alkali is composed of 37 muriatic acid + 48 potash; its combining proportion is, therefore, 85. The composition of the salts affords an excellent illustration of this subject; and, to exemplify it still further, a list of the proportional numbers of a few acids and alkaline bases is subjoined.

Fluoric acid, ...	10	Lithia	18
Phosphoric acid, ...	28	Magnesia	20
Muriatic acid, ...	37	Lime	28
Sulphuric acid, ...	40	Soda	32
Nitric acid, ...	54	Potash, ...	48
Arctic acid, ...	62	Strontia	52
		Barytes, ...	72

Now, bodies uniting according to their proportional numbers, as has been seen above, the proportion of each base expresses the precise quantity required to neutralize a proportion of each of the acids. Thus eighteen of lithia, thirty-two of soda, and seventy-eight of barytes combine with ten of fluoric acid, forming the neutral fluates of lithia, soda, and barytes, and are termed *equivalents* of each other, as well as of fluoric acid. The same fact is obvious, with respect to the acids; for twenty-eight of phosphoric, forty of sulphuric, and sixty-two of arsenic acid unite with twenty-eight of lime, forming a neutral phosphate, sulphate, and arseniate of lime, and these acids, in like manner, are equivalents of each other and of lime. These circumstances afford a ready explanation of the fact, that when two neutral salts mutually decompose one another, the resulting compounds are likewise neutral. If eighty-eight parts of neutral sulphate of potash are mixed with 132 of the nitrate of barytes, the seventy-eight barytes unite with the forty sulphuric acid, and the fifty-four nitric acid of the nitrate combine with the forty-eight potash of the sulphate—not a particle of acid or alkali remaining in an uncombined condition.

The method of determining the proportional numbers, as might be anticipated from what has gone before, is, to analyze a definite compound of two simple substances which possess an extensive range of affinity. No two bodies are better adapted for this purpose than oxygen and hydrogen, and that compound of these is selected which contains the smallest quantity of oxygen. Water is such a substance; and it is therefore regarded as a compound of one proportion of oxygen to one proportion of hydrogen. But analysis proves that it is composed of eight parts of the former to one of the latter, by which the relative weights of their proportions are determined, that of oxygen being eight times heavier than that of hydrogen. Some compounds are next examined, which contain the smallest proportion of oxygen or hydrogen in combination with some other substance, the quantities of each being the smallest that can unite together. Carbonic oxide with respect to carbon, and sulphureted hydrogen with respect to sulphur, answer this description perfectly. The former consists of eight oxygen and six carbon; the latter of one hydrogen and sixteen sulphur. The proportional number of carbon is, consequently, six, and of sulphur, sixteen. The proportions of all other bodies may be determined in the same manner. Since the proportional numbers merely express the relative quantities of different substances which combine together, it is, in itself, immaterial what figures are employed to express them. The only essential point is, that the relation should be strictly observed. Thus we may make the combining proportion of hydrogen 10; but then oxygen must be 80, carbon 60, and sulphur 160. Doctor Thomson makes oxygen 1, so that hydrogen is eight times less than unity, or 0.125, carbon 0.75, and sulphur 2. Doctor Wollaston fixes oxygen at 10, by which hydrogen is 1.25, carbon 7.5, and so on. According to Berzelius, oxygen is 100. The system of Wollaston becomes the same as doctor Thomson's, by merely dividing by 10; that is, by placing the decimal point more to the left by one figure; and then, if we multiply by 8, it is converted into Mr. Dalton's scale, in which hydrogen is the standard.

(To be continued.)

DRAWING PATTERNS, &c.

MR. D. R. HAY, in his excellent work, "The Laws of Harmonious Coloring," has the following practical observations on the method to be followed by young men in gaining a knowledge of drawing, with reference to patterns, decorations, and ornamental designs:—"The course of study I am about to point out is within the reach of all—even those in the most humble situations of life. They will find it of easy acquirement, and a source of continual enjoyment, in the improved medium through which it will lead them to view the most ordinary productions of nature. She shall be their instructor; for all that I can pretend to do, is to point out to them a practical mode of receiving her lessons. To the uninitiated I therefore address myself; and let them not be dissuaded from beginning, by having no predilection for the study—the more they persevere, the more they will love it.

"In the first place, your attempts ought to be of the most simple nature, and on as large a scale as you can conveniently adopt; therefore begin by procuring a black painted board or slate, of from 2 to 3 feet square, and with white chalk practise the drawing of squares, circles, and ovals, without any guide to your hand. You may make yourself copies of these figures by the ordinary rules. When you are tolerably perfect at these, upon the proper combination of which depends all linear harmony, you may practise in the same way triangles, hexagons, octagons, and such other figures as arise from the various combinations of the straight line. Next, by your circular and oval lines, you may form crescents, circular and flattened volutes, regular undulations, and other figures, which arise out of their various combinations, first making an accurate copy to yourself of each figure by measurement, and continuing to practise until you can form it by the eye with perfect ease. Avoid forming your figures by little bits at a time; do each line as much as possible by one sweep of the hand. When you find yourself pretty perfect in this kind of practice, I would recommend you at once to draw from nature. You may take for your first subject a cabbage leaf, the larger the better; and persevere in copying it, full size, until you can represent it accurately in outline, with its principal fibres. You may then vary your practice by other simple subjects of a similar kind, until you find you can do them all with ease.

"Before endeavouring to draw more than one leaf at a time, you must know a little of perspective. The most simple mode by which you will attain such knowledge of the art as will be most useful for your present purpose, is to hang a circular object, such as a hoop, between you and the window; set it moving gently round, recede a little from it, and you will find that, as one side of it retires and the other comes forward, the circle which it describes becomes narrower and narrower, until it disappears altogether, and leaves nothing but a dark line, as if a stick instead of a hoop were hanging before you. I recommend you to do this between you and the window, because the hoop will appear like a dark line, and you will thereby be better able to mark the change that takes place in the shape of the circle. Fix it in various positions, and draw from it, and observe that it is a different figure from an oval. A knowledge of this simple fact is all that you require of perspective in the meantime. You may now hang up your cabbage leaf, or that of any other large and well-developed vegetable, and you

observe the same change in its figure as it turns round. Make an outline of its shape while its front is half turned from you, then bring it from between you and the light, and place it where the light will fall upon it, with its face half turned from you as when it hung before the window. Take your outline, and within it draw the principal fibres as you see them. To do this properly will require a great deal of practice, but it will pave the way to your being able to draw the most complete groups of flowers and foliage that can be placed before you. You may now hang before you a small branch of any tree or plant with two or more leaves upon it—the larger the leaves are, the better—and endeavour to make outlines of them, varying their shape according to their perspective, as already described; be particular on this point, for a great deal depends upon it.

"You may now lay aside your chalk and slate, and provide yourself with a few sheets of common cartridge paper, and some pieces of common charcoal—that made from lime-tree is the best. Stretch a whole sheet of your cartridge paper upon your board by a wafer or a little paste at each corner. Place before you a cabbage, cauliflower, stalk of dock blades, or any such large vegetable, and they will be more picturesque if the outer leaves are hanging loose. Copy these carefully in outline, using your charcoal gently, that any inaccuracy may be easily dusted off. A large thistle with its foliage is likewise an excellent example, but more difficult. Indeed, you cannot go wrong in your choice; hemlock, fern, nettle, are all worthy your study. From these the richest and most effective of Gothic ornaments were taken by our forefathers. The more you study such subjects, the more beauty and grace you will find in their forms."

PREPARATION OF POTATOES.

MR. C. GRELLETT, of Hatton Garden, has patented the following invention for the adaptation of Potatoes to the making of bread, biscuits, pastry, &c. A paste of potatoes is prepared in one of the following ways:—

The skins of the potatoes being removed by a suitably constructed grating machine, the potatoes are boiled and then reduced to a paste. The potatoes are skinned, boiled, dried, and reduced to the state of flour. The pulp of potatoes deprived of the feculent parts is made into a moist paste. Or, the potato pulp is boiled, dried, and reduced to the state of meal. The apparatus for drying consists of a chamber into which hot air is conveyed, having been previously passed over lime, to abstract all possible moisture; this hot dry air is admitted into the drying chamber by sliding valves, and when charged with moisture is drawn off by a revolving fan.

The mill for grinding the preparation of potatoes consists of two vertical stones, whence the meal or flour passes to a bolting-cloth, through which the finest particles fall, the larger being raised by a screw and reground. The fine particles pass through hollow metal columns into a suitable vessel, from which they are moved by an endless screw, turning in a double cylinder, into a box. This double cylinder is of zinc, the internal space being filled with flannel saturated continually with cold water, so as to cool the flour in its passage. From this box the flour is raised, by cups placed on an endless band, into the drying chamber.

BLEACHING OF SILK.

THE coloring matter, which more or less tinges silk with a golden hue, resides in the gum which the silkworm produces in such abundance with the filament, and which exercises so important an agency in facilitating all the preliminary processes of its manufacture.

If the cocoons be immersed in hot water a portion of this gummy or resinous substance will be dissolved, and will impart to the water a light amber color. If alcohol be employed as the solvent a much larger portion of this matter will be extracted from the silk, and a tincture formed, which will retain its color even after it has been exposed to the rays of the sun for a much longer time than would suffice to bleach the silk itself.

The knowledge of the fact, that this coloring matter has a greater affinity for alcohol than for water, led Mons. Baumé to adopt the following process for bleaching silk:—

A stone-ware vessel, of a nearly conical form, and capable of holding about twelve gallons, was provided, having a large opening at the top, and a smaller one, about an inch in diameter, at the bottom. Vessels made of common pottery-ware could not be used for the purpose, as they would speedily have been rendered unserviceable by the acid employed in the bleaching. From the same cause, the stone-ware even proved to be not very durable. All roughnesses on the inside surface of the vessel, which could have broken the threads of silk, were carefully rubbed down with pumice-stone. The small aperture at bottom was closed by a cork, through the centre of which a glass tube, of a quarter of an inch in diameter, was passed; and, except at the time when it was required to draw off the liquid contents of the vessel, this tube also was kept closed by a cork.

Six pounds of yellow raw silk were then disposed in the stone-ware vessel, and upon this was poured a mixture previously made of forty-eight pounds of alcohol (specific gravity 0.867), with twelve ounces of very pure muriatic acid (specific gravity 1.114). The vessel was then completely closed, and the whole was left in digestion, until the liquor, which at first assumed a green color, passed to that of a dusky brown: this usually happened in the course of twenty-four hours. The acidulated spirit of wine was poured continually over the silk, until the liquid passed off perfectly colorless. The silk was then left to drain without being otherwise disturbed. A mixture of the same quantity of spirit with muriatic acid was then again poured upon the silk, which, after being exposed to its action for a period somewhat longer than the first digestion, proved to be perfectly and brilliantly white. The time required for this second application of acidulated spirit was of less or greater duration, according to the temperature, and the original quality of the silk. Baumé found that the bleaching was much more readily accomplished when the cocoons had not been previously baked, for the destruction of the chrysalides. The second dose of liquid was but slightly tinged when drawn off; and if another portion of acid, equal to half the quantity originally used, were added to it, the mixture could properly be used for the first digestion of a second quantity of the raw material. A further washing of the silk then ensued, by pouring upon it forty-eight pounds of pure unacidulated spirit of wine, which was drawn off in the course of the following day.

To recover the quantity of spirit absorbed by the silk, and which was equal to its own weight, small quantities of water were sprinkled over it from time to time, and this process was continued until the liquid, which drained off through the glass tube, had no perceptible strength. Notwithstanding these repeated washings, the silk still retained a portion of muriatic acid, which made it harsh to the touch, and if left in it, would, after a time, have injured its fibre: it was therefore placed in a coarse woollen bag; and this, being inclosed in a basket, was left for several hours in a stream of running water, which effectually washed out the acid. Pieces of manufactured silk, and even made-up garments, have been successfully bleached by the process. The spirit may be recovered by saturating the mingled acid with potash, or lime, and then distilling the spirit in a copper alembic. Mons. Baumé says that silk may be thus made to rival or even to surpass in whiteness and lustre the finest specimens from Nankin.

The revenue regulations, and the dearness of spirit, make the above process impracticable in England, where the usual method of bleaching raw silk is to immerse it into a boiling solution of good soap in river water. After boiling for two or three hours the silk is taken out, beaten, and then rinsed in cold water; when this has been sufficiently performed, it is slightly wrung, then put into cold soap and water, tinged with a minute portion of indigo, and again boiled. On removing the silk from this second water, it is wrung as dry as possible with the assistance of wooden pegs, and is then well shaken to separate the threads: after this it is suspended in a kind of stove constructed for the purpose, which contains sulphur in a state of combustion; the fumes arising from this give the last degree of whiteness to the silk, and the process is completed.

LUNAR INFLUENCES.

THE influence of the moon on the weather has in all ages been believed by the common people; the ancient philosophers embraced the same opinion, and engrafted upon it their pretended science of astrology. Several modern philosophers have thought the opinion worthy of notice; among whom Messrs. Lambert, Cotte and Toaldo, deservedly take the lead. These philosophers, after examining the subject with the greatest attention, have embraced the opinion of the common people, though not in its full extent. To this they have been induced both by the certainty that the moon has an influence on the atmosphere as it has on the sea, and by observing that certain situations of the moon in her orbit have almost constantly been attended with changes of the weather, either to wind, to calm, to rain, or to drought. The moon does not influence great bodies of fresh water as the lakes of Canada—and the Mediterranean is tideless.

There are ten situations of the moon in her orbit, each revolution, when she must particularly exert her influence on the atmosphere, and when consequently changes of the weather most readily take place. These are, 1, the new, and 2, full moon, when she exerts her influence in conjunction or in opposition to the sun; 3 and 4, the quadratures; 5, the perigee, and 6, the apogee (for the difference in the moon's distance from the earth is about 27,000 miles), the two passages of the moon over the equator, one of which M. Toaldo calls, 7, the moon's ascending, and 8, the other, the moon's

descending, equinox; the two lunistics, as M. de la Lande has called them, 9, the boreal lunistic, when the moon approaches as near as she can to our zenith; 10, the austral, when she is at the greatest distance from it, for the action of the moon varies greatly, according to her obliquity.

With these ten points M. Toaldo compared a table of 48 years' observations for Lombardy, and found the result as in the following table; and after examining a number of other tables of observations, and combining them with his own, he found the proportions between those lunar points on which changes of the weather happened, and those which passed without any change when reduced to the lowest terms, to be as in the last column of the table: so that we may wager six to one that this or that new moon will bring a change of weather, and five to one that a full moon will be attended by a change, and so on.

Lunar Points.	Attended with a change of weather.	Attended with no change.	Proportions reduced to lowest terms.
New Moons	523	83	6 . . 1
Full Moons	506	92	5 . . 1
First Quarter	424	189	21 . . 1
Last Quarter	429	182	24 . . 1
Perigee	546	99	7 . . 1
Apogee	517	130	4 . . 1
Ascending Equinoxes	465	142	33 . . 1
Descending Equinoxes	446	152	22 . . 1
Southern Lunistics	446	154	3 . . 1
Northern Lunistics	448	169	24 . . 1

Several of these lunar points coincide with one another, at times occasioned by the inequality of the moon's periodical, anomalistical, and synodical revolutions, and by the progressive motion of the apses. Thus the new and the full moon sometimes coincide with the apogee, or with the perigee, &c. These coincidences are the most efficacious; their changing power, according to Mr. Toaldo, is as follows:—

	Change.	No Change.
New moon coinciding with the perigee	33	1
Ditto ditto with the apogee	7	1
Full moon coinciding with the perigee	10	1
Ditto ditto with the apogee	8	1

The most important maxims of the before-mentioned philosophers, for prognosticating the weather, are the following:—

1. When the moon is in any of the ten lunar points above named, a change of weather may be expected. The most efficacious of these points are the conjunctions and apses.

2. The coincidence of the conjunctions with the apses is extremely efficacious; that of the new with the perigee gives a moral certainty of a great perturbation.

3. The new and full moons that produce no change on the weather are such as are at a distance from the apses.

4. A lunar point commonly changes the state of the weather into which it was brought by the preceding point. For the most part the weather never changes but with some lunar point.

5. The apogees, southern lunistics and quadratures, commonly bring fair weather, for the barometer then rises; the other points tend to make the air lighter, and thereby produce bad weather.

6. The most efficacious lunar points become stormy about the equinoxes and solstices.

7. A change of weather seldom happens on the same day with a lunar point, but sometimes before and sometimes after it.

8. At the new and full moons about the equinoxes, and even the solstices, especially the winter solstice the weather is commonly determined to good or bad for three or even six months.

The lunar period of nineteen years is thought to bring a regular succession of seasons. Mr. Kirwan endeavoured to discover probable rules for prognosticating the different seasons, as far as regards Great Britain and Ireland, from tables of observation alone. On perusing a number of observations, taken in England from 1677 to 1789, he found,

1. That when there has been no storm before or after the vernal equinox, the ensuing summer is generally dry at least five times in six.

2. When a storm happens from an easterly point of the horizon, either on the 19th, 20th, or 21st of May, the succeeding summer is generally dry four times in five.

4. If there be a storm at S.W. or W.S.W. on the 19th, 20th, 21st, or 22nd of March, the succeeding summer is generally wet five times in six.

Dry winters are (in high latitudes) cold, and moist winters warm: on the contrary, dry summers are hot, and moist summers cold. So if we know the moistness or dryness of a season, we can judge of its temperature.

To these maxims of Mr. Kirwan have been added a few others, the truth of which has been confirmed by long-continued observation.

1. A moist autumn with a mild winter is generally followed by a cold and dry spring, which greatly retards vegetation.

2. If the summer be remarkably rainy, it is probable that the ensuing winter will be severe; for the unusual evaporation carries off the heat of the earth.

3. The appearance of birds of passage early in autumn announces an early and severe winter; for it denotes that winter has already commenced in the north.

4. When it rains plentifully in May, it will rain but little in September.

5. Violent temperatures, as storms or great rains, produce a sort of crisis in the atmosphere, which brings a constant temperature, good or bad, for some months.

6. A rainy winter predicts a sterile year. A severe autumn announces a windy winter.

Notwithstanding the imperfections of our present knowledge of this subject, the number and ability of the philosophers at present engaged in the study cannot fail at last to be crowned with success; and perhaps a rational and satisfactory theory of the phenomena of the weather is not so far distant as we at present suppose.

BRITISH QUADRUPEDS.

THE history of our native animals is naturally more interesting to the generality of readers, than of such as do not come under their own immediate observation; while to be ignorant of the names and properties of beings which every where surround us, is neither a proof of wisdom nor of a well-informed mind. Those who take an interest in the works of nature begin by examining objects immediately within their reach; and as few can extend their inquiries beyond such limits, the productions of every country will be best known, in proportion to the taste for such inquiries among its inhabitants.

The zoology of Britain was first investigated by Ray, the great father of natural history, since the

revival of learning after the darkness of the middle ages. This wonderful man must be also considered the true founder of natural history in Britain; and by his instruction and his assistance, the name of his friend and patron Sir Francis Willoughby shares a portion of the same immortal fame. But our native zoology, even at that period, engaged the attention of another labourer. The name of Lister must therefore be honoured, in conjunction with that of Ray, as having been the first who undertook to investigate the extensive order of molluscan animals: these he arranged with such an admirable perception of natural affinities, considering the period in which he wrote, that we know not which to admire most, the acuteness of his views, or the magnitude of his undertaking. To these we must add the name of Ellis, whose work on Corallines, printed in 1755, has continued until the present day to be the most elaborate and valuable publication on this class of animals that has yet appeared: a long interval then succeeded, during which naturalists employed themselves merely in describing species, and in illustrating the Linnæan nomenclature. The only writer, of this period, whose works are now of importance, was George Edwards, whose *Natural History of Birds* pretending to nothing more than plain and accurate description, free from all scientific arrangement, has become, from that very cause, of great and general service. A return to a more accurate observation of natural groups first appeared in the *Lepidoptera Britannica* of Haworth, and in the elaborate work upon our native bees by Kirby; from these we may date the revival of natural history in Britain, from a vocabulary of words to an intellectual science. Although not absolutely connected with our more immediate purpose, we deem this rapid glance over the history of the science in Britain will not be an unwelcome preface to the following remarks.

The zoology of the United Empire might be treated of under the three kingdoms of which it is composed; were our materials sufficiently ample to mark the peculiarities of each. But it unfortunately happens, that although every year witnesses an accession of new species enrolled in the annals of our native fauna, no attempt has yet been made to generalise these discoveries, with reference to the geographic range of groups or species. Local catalogues of the animals found in a few counties have, indeed, been drawn up; but these, however valuable in themselves, are too scanty to allow of more than a partial insight into the general subject. The zoology of Ireland has been sadly neglected, and we are still without a Fauna Scotia. Thus embarrassed we must consider the natural history of Britain in the aggregate; noticing such species as more particularly belong to the northern and southern extremities.

Of quadrupeds, the most recent catalogue contains sixty living species, including the whale tribe; besides those which progressive civilisation, and the effects of the chase, have now extirpated from our islands. Nine species of bats have been detected, four of which have as yet been found only in the southern and western counties: two belong to the division of horse-shoe bats, so named, from their nostrils being furnished with a complicated membrane, like a horse-shoe; an appendage which is probably intended to act as a sucker to assist the animal in retaining its prey. Another, the *vespertilio murinus*, or common bat, as we are informed by White, has been so far tamed as to take flies out

of its master's hand, carefully throwing aside the wings. Our woods and heaths still shelter the hedgehog, a harmless and most useful animal in destroying snails, slugs, and worms; but persecuted by the vulgar for a long list of imaginary and nonsensical properties. These prejudices have been extended to the mole, whose little hillocks form the best top-dressing, as a sensible farmer once assured us, to poor lands, that can possibly be given: their soft fur has long been mixed with that of the beaver, in the making of hats. Allied to the mole, in general conformation, are the shrew mice, of which two species are natives, the common and the water shrew (*Sorex araneus* and *eddens*): both these appear to be widely distributed. Of true mice we possess three distinct sorts: the common or house mouse, the field mouse, and the harvest mouse; the latter being as destructive to the farmer as the first is to the housewife. The brown and the black rat infest our dwellings, and are equally injurious: the latter is known by the tail being longer than the body; whereas, in the brown rat, both these parts are equal. The pretty little dormouse (*Myoxus velleianus*) is a general favourite, and, like the squirrel and jerboa, eats its food in an erect attitude, sitting on its haunches, and using its forefeet as hands. The water rat and short-tailed mouse of Pennant (now placed in the genus *Arvicola*) occur in England: but the former is stated not to have been found in the northern islands; the latter is a most destructive little animal in gardens, where it grubs up seeds, particularly peas, just after they have begun to germinate. A few years back, the short-tailed mouse suddenly appeared in immense numbers in the New Forest, and notwithstanding every artifice employed to stop their ravages, they destroyed many thousands of young trees, and devastated whole acres of young plantations.

The badger was formerly a much more common animal in Britain than at present. It is a nocturnal feeder, sleeping in its hole during the day, yet, when attacked, is remarkably quick in its motions, and successful in its defence. If undisturbed, it is harmless and inoffensive, chiefly subsisting upon vegetables, although it will likewise devour frogs and slugs. It is stated to inhabit Sweden, although it does not appear to be known in the north of Scotland. The otter has likewise become much less frequent of late years; it was formerly considered as a beast of chase, as our old game books mention otter hounds as particularly trained for hunting this animal. It feeds entirely upon fish, which it dives after with great celerity; and, unless pressed by extreme hunger, invariably leaves the tail extremity untouched. The legs are very short; and the toes being connected together by a membrane, gives to the animal the power of swimming very rapidly.

Our rapacious or carnivorous quadrupeds are very few, and from their small size too insignificant to inflict much personal injury upon man. The bear and the wolf have long been extinct in Britain, and the fox might possibly have shared the same fate, had it not been preserved as a beast of the chase since the extirpation of more formidable game. Pennant mentions three varieties of this animal found in Wales and other mountainous parts of Britain:—1. The milgri, or greyhound fox, is the largest, tallest, and boldest, and is distinguished by a white tag or tip to the tail. 2. The mastiff fox, which is less, but more strongly built. 3. The

curgi, or cur fox, of a still smaller size, and having the tip of the tail black. The varieties do not appear, however, to have fallen under the actual observation of subsequent naturalists, either British or continental.

(To be continued.)

DETECTING GUM, DEXTRIN, &c.

M. TROMMER has made several experiments to find out a method of distinguishing the above substances in solution; the method advanced is founded on their different actions towards the sulphate of copper when a free alkali is present. Gum solution gives a blue precipitate, which is insoluble in an alkaline liquor, but is soluble in pure water, and can be boiled without becoming black; a proof that it is not the hydrate of the oxide of copper. Starch and gum tragacanth exhibit the same action; a solution of dextrin affords a deep blue-colored liquid, without a trace of precipitate, which, when heated to 85° C., deposits a red crystalline precipitate of red oxide of copper, which dissolves completely in muriatic acid. In this way he found, that on the conversion of starch into dextrin and so into grape sugar, not a trace of gum is formed as intermediate product; if a precipitate was obtained, it resulted from undecomposed starch, which might be easily recognized by the addition of an aqueous solution of iodine. If a solution of grape sugar and of potash be treated so long with a solution of the sulphate of copper as the separated hydrate of the oxide of copper is redissolved, in a very short time a precipitation of the red oxide of copper takes place at the common temperature; if the solution is warmed the red oxide is immediately separated, even when a small quantity of the sulphate of copper has been employed, and the liquid soon becomes colorless; a liquid containing ~~rather~~ of grape sugar gives, when boiled, a perceptible precipitate; and when it contains ~~rather~~, a distinct red coloring is seen when the light is let fall on it. A solution of cane sugar with potash, treated with the sulphate of copper, becomes of a deep blue; it can be boiled, when potash is used in excess, without any separation of the red oxide of copper, which results only after continued boiling, or when left to stand for several days; but even after several weeks the whole of the oxide has not been reduced. Milk sugar acts like grape sugar. This method is of importance in detecting small quantities of grape sugar in the chyme, chyle and blood; the author had not been able to detect any in the latter.

QUERIES.

- 1.—Phantasmagoscope—What is the construction of this instrument, and where described or to be seen?
- 2.—Automaton Artist for taking profiles, &c.—How is this constructed?
- 3.—How are the lime cylinders to be made for the oxy-hydrogen microscope, and what quantity of gas is consumed per hour?
- 4.—How are steel engravings to be transferred to glass that they may be used as microscopic objects?
- 5.—The Elizabethian twist—How is this particular kind of screw to be executed in the lathe?
- 6.—How are gun barrels so to be bronzed or colored as to show the twist of the barrel?

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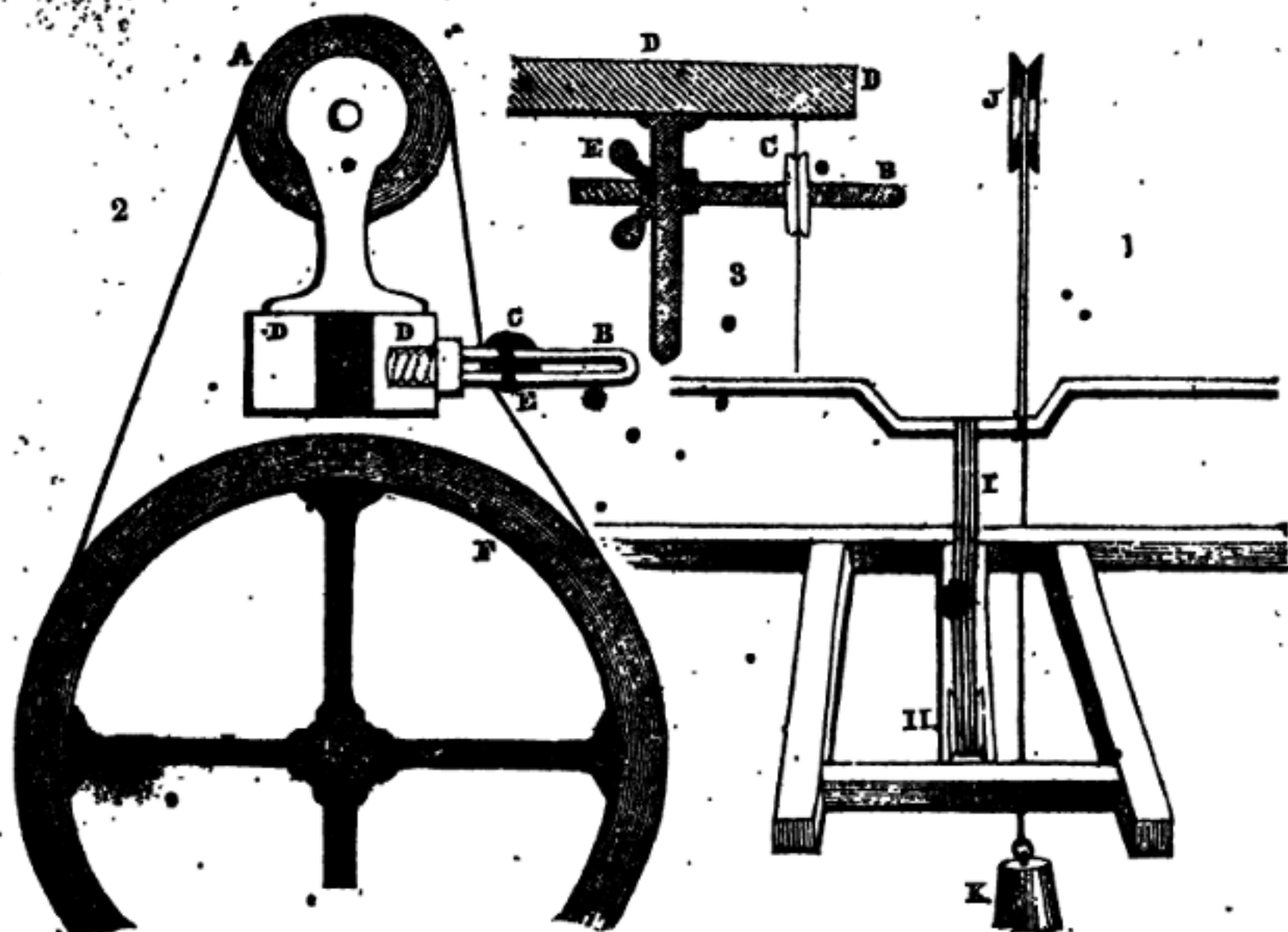
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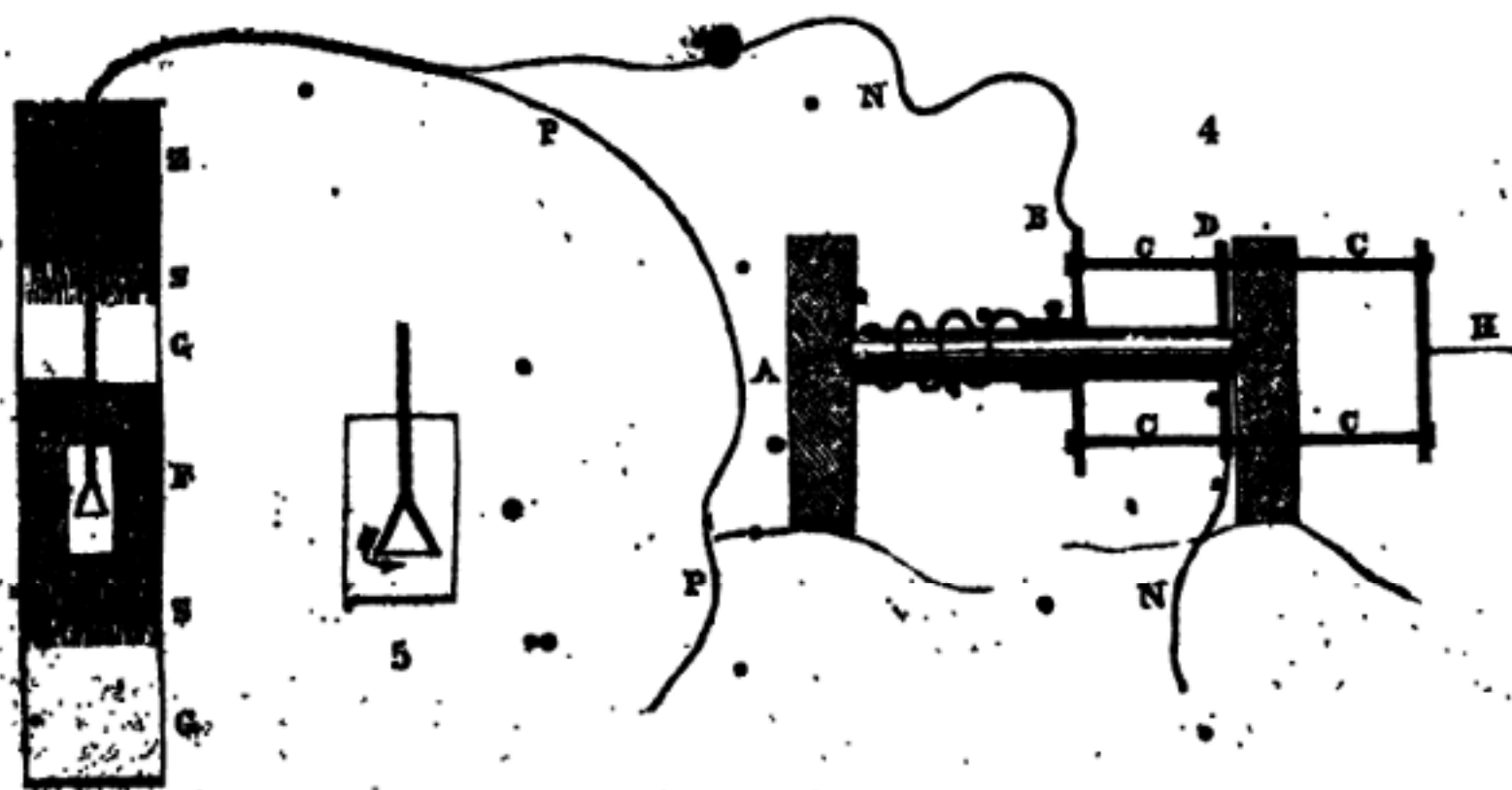
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NEW EDITION.

[1d.]



IMPROVEMENT IN THE LATHE.



BLASTING ROCKS BY GALVANISM.

IMPROVEMENT IN THE LATHE.

(To the Editor.)

DEAR SIR.—You having lately inserted in your Magazine a communication of mine, I am induced to send you the present; which, although in all probability known to some of your readers, is not generally so. As an amateur turner, I am glad at all times to obtain even the slightest information in my favorite pursuit, and am equally willing to communicate.

Fig. 1, is a recent improvement in the treadle of a lathe; I know not to a certainty, who is the inventor, but I believe it to be Mr. Buck, of Newgate Street, who turns out some very excellent lathes. The centre bar of the gate-treadle, as may be seen by the cut, has a pulley H, about 3 inches in diameter with a raised rim about $\frac{1}{4}$ of an inch, and instead of the usual strap of iron, has a strong catgut with hook and eye I, passing four times under it and over the crank; with this action all friction, or as near as possible, is got rid of, the gut not sliding but turning on the crank, which it is enabled to do by the pulley turning as much as is required each rise and fall. Seeing this improvement, I adopted it, and find it so good in practice, that I would by no means again use the old method.

The cut also shows another trifling addition I have made to the treadle, but which has no connection with the former; it fully answers the purpose I intended it for and may do that of others similarly circumstanced. Having no slow movement to my fly-wheel and requiring one, I simply put on the crank a ring of steel wire A, from which there is a catgut passing over a pulley J, about 5 inches diameter, attached to the back of the lathe bed and through a hole in the floor into a cellar below, having a weight K at its end; the longer the line the steadier its action, the foot passing down and the weight pulling up the crank, enables the turner to resist the rise of the treadle, and, consequently, to regulate the pace. The space these pulleys turn in require to be very nicely fitted to prevent the gut or line getting off the pulleys.

All turners are occasionally annoyed by the slackness of the band; to remedy this, I have in the front part of the lathe-bed, immediately below the mandril pulley, fixed a piece of beech wood about 9 or 10 inches long, projecting straight forward, as seen in Fig. 2, a section of the lathe-bed; A, the mandril pulley. B the piece of beech wood. C the regulating pulley. D D the lathe-bed. E, the thumb-nut. F the fly-wheel. This piece of wood has a slot in it to allow a spindle carrying a pulley, as shown in Fig. 3, to be fixed at any distance required, the spindle having a shoulder on the one side, and a thumb nut on the other enables it to be secured in an instant, and the length of the spindle allows the pulley to run on any part so as to coincide with any of the grooves in the mandril-pulley.—Your's, &c.

Hornsea, March, 1842.

JAMES WILCOX.

BLASTING ROCKS BY GALVANISM.

We gave an account in Vol. I. of methods whereby gunpowder might be fired by the galvanic current; applying it to submarine explosion and other purposes. The well-known operations of Col. Pasley on the wreck of the Royal George have called this power into exercise for other similar purposes; among others, that of blasting rocks, instead of by the use of fuses or quick match, which are al-

ways of uncertain operation, and sometimes, from their exploding too soon, even of danger. There are numerous modifications of the apparatus for this purpose by galvanism, but that most usually employed is the invention of Mr. Roberts. It is as follows:—N P, Fig. 4, represent the positive and negative wires from a galvanic trough, each wire being surrounded with cotton, so that electricity cannot pass from one to the other, except by the small wire at the end of them, as represented in the magnified figure, with the attached arrow. This little wire connecting the positive and negative wires, becomes incandescent when the galvanic trough is put in action, detonates the gunpowder in the cartridge in which it is contained, which inflames the additional gunpowder F in which it is imbedded: S S represent straws used for supporting the gunpowder and the sand, &c. Z. The effect of the powder is increased, according to Mr. Roberts's views, by leaving atmospheric air above and below it, as at G. The galvanic trough being arranged and in action, the moment the string H is pulled, it moves the light frame C C C C, and causes the metallic plate B, previously held back by a spring coiled upon the wooden frame A to touch D, and the galvanic circuit being now completed, electricity passes at once from P to N, detonating the gunpowder as the little wire is ignited.

The metallic wires do not require to be above 20 or 30 feet long, and the operator may retire to any distance before he pulls the string H; the effect of the blast is considerably increased by there being no vent required as in the usual mode of igniting gunpowder. A trough, with 20 pairs of plates, the plates being 4 inches square, does very well for the purpose. It may be charged with a solution of sulphate of copper acidulated with sulphuric acid. The metallic wire in the gunpowder connecting the positive and negative poles of the trough cannot be too small; it may be made of platinum, but steel wire has been preferred.

ELECTROTINT.

THIS is an art resulting from the electrotypes, and consists in the making a drawing of a peculiar character upon the surface of a metallic plate, and afterwards depositing copper upon that drawing by means of the electrotypes; the material forming the drawing being of a thick consistence causes slight elevations, which in the cast made from it will of course be depressions beneath the general surface. Copies of the drawing may therefore be printed from the cast in the same manner as copies are taken from an engraved copper-plate. This valuable process, which is patented by Mr. Palmer, of Newgate Street, London, and in whose window are to be seen most splendid prints thus executed, enables the artist to make his drawing, and afterwards to procure a plate fit to be printed from, without the delay or expense of employing an engraver. We might describe the process in our own words, but prefer giving the specification of Mr. Palmer, that our readers may at once see the exact process as explained by the best authority, that of its inventor and patentee.

"Having first obtained a silver, or German silver, or albata, a copper or other metallic plate, or surface made metallic for the purpose of electrotyping, of the required size, which will not be prejudicially acted on by the solution used, with its face whitened if copper be used, either by a deposit of silver by

electric deposition, or a coating of silver plated on it by other means, or by a coating of platinum, or any other white metallic or conducting surface or surfaces, made metallic or conducting for the process of electrotyping, and having soldered or otherwise suitably affixed a small strip of copper to the back of the plate or surface, for the purpose of connection with a voltaic battery, the artist can make his outline in any way considered the most suitable, to which making an outline I make no claim. If the electrotype painting be made from the life, the composition hereafter to be described can be used with a sable pencil, if slightly thinned with spirits of turpentine; but, if the artist be desirous of transferring the outline of a sketch already made, it may be traced in the ordinary way, and rendered more permanent by slightly scratching the surface. When a satisfactory outline has been obtained, the plate or surface is to be placed in such a position as to reflect the window of the apartment, or a white surface of some kind, such as an engraver's shade, in order to see more clearly the work as it is produced on the surface of the plate; if the surface be a dull white or aquatint ground, this is not absolutely necessary.

"The painting may then be proceeded with, the polished or white surface of the plate being left uncovered in those parts where absolute white is required, the composition laid on thickly and roughly in the dark and black portions, and the intermediate shades rough and thick, in proportion to the degree of the 'color' or 'tone' required. It is necessary to bear in mind, that a picture painted smoothly, especially in the dark parts, however perfect it may appear on the plate, will not produce an impression capable of receiving and transferring the printing ink in an equal degree, as the rubbing which it undergoes to take off the superfluous ink, renders all the smooth portions of the plate nearly bare. To obtain a regular roughness, sufficient to retain the printing ink, and at the same time to produce an appropriate 'texture,' various modes of 'handling' may be employed; for instance, a flat tint, made by spreading the composition over the plate, and striking a fitch or hog-hair brush perpendicularly all over it, will give an impression in the electrotype plate, that will retain the printing ink by numberless minute indentations. Cut brushes, of different sorts, make a series of continuous lines on the plate, of different degrees of fineness, which form corresponding indented lines in the voltaic deposit, capable of receiving and transferring the ink, so as to produce the same effect on paper, or other material, as had been previously obtained on the plate. A mixture of the styles of handling already mentioned, will be found useful; that is, the texture produced by the cut brush being slightly softened by dabbing the fitch brush perpendicularly on it. A 'dragged' texture can be produced by passing a soft brush, held in a slanting position, quickly over the surface, after the brush has been well filled with the composition, slightly thinned with spirits of turpentine. This can be done over a tint already laid on, if a little care be taken not to disturb the composition. The modes of handling may be varied, so as to obtain the texture an artist may desire.

"The composition to be used by artists in the electrotype paintings, is made of the under-mentioned ingredients. I do not, however, confine myself thereto, as the same may be varied. One part, by weight, of white wax, two of lard, and one of

lamp-black, melted together, and stirred till nearly cold. To render this composition fit for use, it is to be ground with a small quantity of olive oil. The consistence required, depends in some measure on the nature of the subject; it ought to be thin enough to work freely, and yet sufficiently firm to retain the position it is placed in without spreading. This composition never dries, and consequently can be removed from the plate, or its position altered at pleasure. The brushes requisite are those commonly used by artists; sable, hog-hair, fitch, and camel's-hair, either in the common form, or cut in different ways, to facilitate the production of the effect intended, as is well understood by artists; points of wood, ivory, and metal, will be occasionally required, and also a dabber of silk, or other material. The painting being finished by the artist, it is to be slightly touched in the dark parts with plumbago (in fine powder) or other suitable material for making the surface conducting, with a soft pencil, and submitted to the electrotype process, which is now well understood; by which means a metal plate is produced, capable of transferring to paper, or other material, a fac-simile of the original painting. If any of the tints should prove too dark, the burnisher, scraper, or other tool may be used, and any portions not sufficiently dark may be touched with the graver, or etched, the same as an ordinary copper-plate. When it is desired to produce a washy texture, I prefer a composition as follows. Mix equal parts of wax and ivory black, ground with olive oil, and made thin with spirits of turpentine. This may be used with any of the brushes already mentioned. A soft brush containing plumbago, passed over the painting, will tend to harden the composition, and make the surface a conducting surface.

"I will now describe the second part of my invention. The required subject is painted on a darkened or black copper or other plate, with a white or light colored material, so as to produce the effect intended, by means of such brushes or tools as will leave the composition in lines or dots capable of making an impression in the electrotype plate, sufficient so as not to come in contact with the printing roller; whilst those parts of the darkened copper which are left visible, either in lines or dots, will, when electrotyped, receive the ink from the roller, and when printed from, transfer an impression to paper, or other material. The composition used is made in the following manner: two parts, by weight, of sulphate of lead, two of lard, and one of wax, melted together, and stirred till nearly cold. This composition is not likely to be too thick; a little olive oil can, however, be used with it, if it should prove so, and if too thin, more of the sulphate may be added: the composition should be well ground before it is used. The brushes recommended for this 'surface electrotype,' are the cut brushes, of different degrees of fineness, mentioned as being applicable to the first process; sable pencils in their common shape, points of ivory, &c., and an instrument with several projecting points, somewhat resembling a comb, after the outline of the subject has been made in any way, so as not easily to be obliterated. Those parts of the plate which are intended to be black are left bare; the intermediate shades between black and white are obtained by painting with the cut brushes, which will leave lines, or points of composition, of considerable projection. Broad portions of light are obtained by heaping on the composition to the thick-

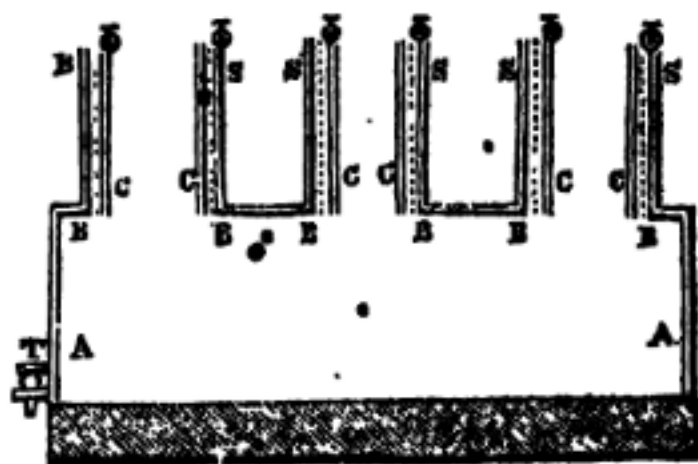
ness of one-eighth of an inch, or more, in proportion to the size of the masses of white. In those instances where a white back ground, or very large portion of white occurs, it is only necessary to raise a wall of the composition, about an eighth of an inch thick round the edge of the subject, as the copper, &c., beyond the wall, can be protected by sealing wax or other suitable varnish. Flat tints, for flesh, back-grounds, &c., can be formed by striking a fitch, or other brush, perpendicularly, so as to produce numberless projecting points, which make corresponding indentations on the deposit, too deep to receive any ink from the roller. A beautiful 'dragged' texture is produced by using the composition thinned a little with spirits of turpentine, with a soft brush, held in a slanting direction, and passed quickly over the surface; this leaves the composition in a series of raised dots on those parts of the surface over which the brush has passed. In this manner may a suitable conducting surface be prepared for obtaining an electrotype plate or surface, using plumbago, or other suitable material, to make the surface conducting, where the surface is covered with composition, as above explained.

"As it is sometimes necessary in printing from wood blocks to lower the light parts, so also is it sometimes necessary in electrotype surfaces, according to this part of my invention.—I will therefore describe the means I practice for lowering the light parts, though other means may be used:—I take a sheet of mill-board and fold it in the middle, so that the two flaps or sides may fold on each other without shifting. I then take a number of sheets of paper, according to the depth I wish the plate to be lowered, and affix them to one flap. I then trace on the upper sheet the outline of the parts to be lowered. I then with a penknife cut through all the sheets where the plate is to be most lowered, and only through a portion of them in other places, according to the depth required; taking care that the edges are cut on a bevel or slanting edge, and not a sudden or vertical one. The portions which have been cut out must now be rubbed over with paste or cement, and the other flap of mill-board shut on them to which they will adhere: this is to be repeated until all the pieces cut out are taken from the holders, and thus the parts cut out, will project on the surface of one part of the mill-board, and, when shut, will exactly fit into the hollows cut from the sheets of paper resting on the other surface of mill-board. I then take a polished soft copper-plate, and place it between the flaps of mill-board, in such manner that the plate will have the projecting surface produced by the cut-out paper on one side, and the sheets of paper with the hollows on the other side; and I submit the whole to pressure—by which means the plate will be undulated, in those places where the paper has been cut out, and to a degree depending on the depth to which the paper has been cut out; and as such lowering is according to the outline of the design which is to be painted or produced on the plate, the lowering will be in the proper places for the design. The artist will now proceed in painting and producing the picture or design on the plate; from this plate or surface an electrotint surface is to be obtained, as before described. In some instances the drawing can be made on a flat ground, and the electrotype block entrusted to the wood-cut prover, who would prepare it for the ordinary printing press; or these effects may be produced by other means."

BROWN'S GALVANIC BATTERY.

(To the Editor.)

SIR,—I have lately seen a galvanic battery with plates of platinized silver and zinc. However excellent these may be, they have one great disadvantage; the jars allotted to the plates are so small, that to continue the action acid must be poured in at short intervals; this causes an irregularity in the action of the battery, the power being strongest when the acid is first poured in, and gradually decreasing in power as the acid becomes saturated with zinc, which, being held in solution in the jar, also causes an impediment to the action of the battery, so that the solution of zinc must be poured out and fresh acid and water substituted for it. But a method has occurred to me in which these evils may be easily remedied; my arrangement consists of a square box A A, as large as an ordinary tray, for holding six galvanic jars, and twice as high, with six holes,



three of which are shown at B. S S are copper, or platinized silver cylinders, fitted water-tight into the holes of the box, these cylinders form the negative plates of the battery. C C are zinc cylinders placed in the interior of the platinized silver cylinders, with a membrane (marked by the dotted lines,) placed between them, the box A is covered on the inside with electric cement, and, when the battery is to be used, water mixed with a due proportion of acid is poured into the box through either of the cylinders until the box is full, and till the cylinders are nearly filled to the top. The advantages of this battery are evident, it will not require fresh acid to be poured in at short intervals, while the dissolved zinc, instead of remaining between the plates S and C, and obstructing the action of the battery, will be distributed through the fluid in the box A A; thus leaving an unobstructed passage for the electric fluid through the liquid in passing from the zinc to the copper. This battery is not more expensive to work than those whose plates are placed in jars, because the same quantity of acid solution is required to do the same work, whether a large or a small quantity is used at a time. To electrotypists, this battery is recommended from the great nicety with which the quantity of electricity can be regulated, without stopping the battery while it is in action; this is done by exciting more or less of its surface. A stop-cock is placed near the bottom of the box at T, when the quantity of electricity required can be regulated by opening it, and letting a portion of the acid and water run out. This battery is adapted for those who require a long continued and steady action, and it is evident, that its action will depend upon the size of the box A, for if this is large, the action will continue for weeks without intermission, and may be made to continue for months.

J. S. BROWN.

PAINTING AS AN ARCHITECTURAL DECORATION.

(A paper read at the Royal Institute of British Architects, by E. F. Parris, Esq., Feb. 14, 1842.)

THE covering large surfaces, and the representation of subjects and ornaments by color, is performed in either what is called fresco, distemper, encaustic, or oil (with varnish or without) termed flatting.

Oil painting consists in using pigments mixed with oils, gums, or other vehicles, for the transparent colors, and with opaque bodies, such as white lead, and metallic oxides, for the lights; the extensive range or scale from light to dark, through all the varieties of color, from the most delicate tint to the most juicy richness, gives it many advantages for general purposes, which no other mode possesses; the ease with which it is worked, the numerous re-touchings, toning, scumbling, glazing, &c., renders it a most fascinating medium to convey the ideas of the artist to the canvas, panel, or wall. Durability is another of its advantages; and it would appear to possess every requisite for embellishing the ladies' boudoir, the picture gallery, or public edifices of the greatest magnitude, or most severe character.

But upon mature reflection it will be seen, notwithstanding the extensive powers of oil painting, that it is used to the best advantage when applied to certain sizes and positions, and when confined within panelling or framing, and so placed as to receive the light from a particular angle, as its glossy surface reflects all objects before it. The ceiling by Rubens at Whitehall will explain this; for since it was last cleaned, the canvass of the centre oval appears quilted, in consequence of the cords which suspend it rendering the surface uneven, and it can only be seen from a very few parts of the chapel without those shining little spots. The same cause operates upon oil painting, when applied to staircases, coves, and curved surfaces. The staircase and saloon at the British Museum, the hall at Greenwich Hospital, and other places, are examples of its misapplication. It may be stated in answer to this, that there are many paintings on a large scale which do not shine; this must be allowed, but the cause is that they have from age, &c., become mealy and dry in their shadows, losing all their transparency and richness, and in many cases the dark colors are covered with a grey cloud, and the usual cry is—How much they want varnish.

I am also aware of the various methods used to destroy the gloss of oil pictures when placed opposite to windows, as starch, rice, white of egg, and spirits, with several others; but in every case that I have seen and tried, the richness of the deep colors and shadows are reduced to the dullness of distemper; the excessive blackness in the staircase at the British Museum, &c., is occasioned by the boiled oil used in preparing the grounds to prevent damp from coming through; this never occurs in pictures painted with pure oils. Many attempts have also been made to unite the qualities of fresco, encaustic, and distemper with oil, by using one over the other.

Painting in distemper, or body color, is so inferior to oil, that few artists in this country practice it for pictures, although much used in Italy. Yet it has some important qualities which fit it for purposes wherein oil would fail; it is a mixture of colors, with whitening and size, gum, white of egg, or other glutinous substances; it cannot be softened or

blended without great difficulty, so that in most cases, where finish is required, the several tints are carried into each other by hatching with the point of a hair pencil, as in the Cartoons of Raffaele at Hampton Court. Its extraordinary power of reflecting light equally, renders it best adapted for scenery and gay light decoration. Its chief characteristics are, that it represents air, distant landscape, architectural objects and sculpture, better than by any other means (when on a very large scale, and the spectator is kept at a distance), for on approaching it appears dry and unfinished. Its chief objection for architectural decoration is, that it suffers from damp, and is removeable with a sponge and water. Most colors can be used in distemper, even some that are useless in oil, as verditer and others; all the bright and rosy tints are seen to the best advantage when used in distemper.

Painting in turpentine, or as it is termed flatting or dead color, is a modification of oil painting, no varnishes being used but turpentine alone (excepting the oil in which the colors have been ground). Its qualities are very similar to distemper, with the advantages that the colors may be blended and softened into each other; but dispatch and rapidity of execution is necessary, or the painting will shine in those parts where the brush has passed frequently over. It represents air and distant landscape equal to distemper, and may be carried to the extreme delicacy of finish; but on a very large scale, it loses its force in the shadows, reflects considerably less light, and appears weak in comparison with distemper; it is as durable as oil would be without varnish.

As to encaustic painting, I must confess my inability to explain its best qualities, or do it justice, the few experiments I have made and seen not being sufficient. Its general principles, however, consist in a mixture of gum mastic, wax, and gum arabic, boiled in water, and used with powder colors on dry plaster, canvass, or panel; after which a coat of melted wax is spread over the whole, and a hot iron applied to drive the wax into the painting, and to incorporate with the colors, by which they are rendered more transparent and bright. Another way is to prepare a ground of wax, paint upon it with distemper colors, and when dry apply hot irons, and it will be fixed.

In all my experiments, I never have been able to remove a cloudy appearance, or to drive in the wax equally, when on a surface of any size; but I believe the recent discoveries of the French artists have brought it to maturity. It was much tried a few years ago, and I have seen several pictures which were thought successful, but they never exceeded eighteen inches square, and had a semi-transparent appearance (from the wax) like marble; they must be very permanent, and resist the damps of a moist climate. Durability without gloss is its chief advantage, it can be re-touched and painted upon at any time, so that careful cartoons, and a thorough knowledge of drawing are not so essential as in fresco.

Fresco, a term not generally understood, was greatly talked about 20 years ago, and at last has become a question of national importance. It was supposed a secret and mysterious operation, whereas of all other modes of painting it is the most simple; I am therefore astonished that many writers upon it, and some of them artists, should bring forward such opposite opinions, when a single experiment would prove the permanency of the colors, and explain the whole affair.

From numerous experiments I have made, I believe that all our usual mortars will answer equally well, as far as the operation of applying the colors. The durability of the stucco is another consideration; the practical plasterer will know what mixtures work the best, and the experienced architect can inform us of the materials to endure the tests of time and climate.

I think it not likely the Greek artists used exactly the same composition for their stuccos in their own country, as they did at Pompeii and Herculaneum, or that Masaccio, Michael Angelo, or the Sicilian artists, painted on a preparation, precisely the same as those now practising at Munich, and I am convinced that the painter will find walls, and stuccos, ready prepared to his hands for fresco, as good as he can desire, either in England, Russia, India or America.

The process consists in laying and spreading very even, a mortar composed of lime mixed with either sand, pulverized flint, bricks, or glass, and while it is fresh and moist, to apply colors prepared from earths and minerals, mixing them with water; the whole will become chemically incorporated and fixed when the stucco is dry, and will become so hard by time as to bear rubbing with a wet sponge or cloth. It must be remembered that vegetable colors will not stand. Those to be used in fresco painting are few, of a deep sober tone, of great intensity, and are very brilliant when judiciously contrasted. In this the knowledge of the artist is called forth, as in every other method of painting, and a very little practice will teach him the few changes which take place in the drying of his tints. Although small works of the greatest excellence have been executed, and by the first masters, yet the proper field for fresco is in figure subjects on extended surfaces, and it is most effective when in conjunction with sculpture and architecture.

As a decoration, it surpasses every other mode of painting; its grand and impressive tone of color, with a boldness and decision of outline rejecting all meretricious ornament, and its combining with large masses of architecture, give a dignity and majesty commanding silence and admiration.

I must observe that much of the richness and brilliancy of fresco, depends on the stucco ground reflecting light through the colors, and Indian red, when applied on a large surface, appears as beautiful as the richest lake in oil. The colors never grow darker, nor do they suffer from absence of light. Their durability is beyond a doubt.

A very general impression exists, that any painting done on a wall is fresco. This is a mistake, as none of the works by Thornhill, Verrio, and others, are in fresco, but in oil; also that the scenery at the theatres is fresco; they are not so, but in distemper. In fact nothing can properly be called fresco that is touched after the fresh mortar is dry and it is moreover supposed that the English artists are entirely ignorant of this mode of painting. This again is not true; many have tried and succeeded; and there is an interesting account in the "Art Union," of last year, describing a work by Thomas Barker of Bath, thirty feet long, and twelve high, full of figures the size of nature, painted in 1822, about the time that the German artists commenced fresco painting.

Fresco painting, ancient stained glass, objects in terra cotta, bronzes, tessellated pavements, with painted and gilt monumental effigies, armour, and old tapestries, seem to partake of the same quali-

ties, that of a sober, powerful, rich, and if I may so use the expression; a ponderous character, which accords not only with each of these, but with every style of architecture.

In opposition to this painting in distemper, turpentine and oil require to be modified or humoured to suit the exact tone of the apartment; the Venetian artists well know this, and their oil pictures were frequently painted very rich and dark, to harmonize with colored marbles, velvets, brocades, embroidery, and carved ebony, with which they were surrounded, but as form and outline were absorbed in those powerful effects the higher style of art became disregarded.

Enough was done by Rubens to show the value of painting as an architectural decoration; and although the possession of the cartoons produced no commissions for our native artists, yet the nobles engaged Verrio, Rizzi, Pelegrini, Rousseau, Delafosse, and others, to cover the walls and ceilings with their preposterous deities in silks and satins, powder and perriwigs.

Thornhill, an Englishman, endeavoured single-handed to form a school for this country, which was encouraged while he lived. It is however stated by his son-in-law Hogarth, "that the upper end of the hall at Greenwich, where the royal family is painted, was left chiefly to the pencil of M. Andrea, a foreigner, after the payment originally agreed upon for the work was so much reduced as made it not worth Sir James's while to finish the whole with his masterly hand."

It is curious to note the scale of charges for architectural decoration for the last 200 years. That is from the arrival of Rubens in 1630 to 1730, when Thornhill was in his zenith; and from 1730 to its almost total extinction in 1812.*

1630	Rubens, for Whitehall ceiling	£27 10	per yard.
1670	De la Fosse, British Museum ..	7 0	"
1690	Verrio, exclusive of painting (with 3000 per annum when blind) ..	3 12	"
1725	Thornhill for Greenwich ..	3 0	"
1730	Do. plaster ..	1 0	"
1755	Cipriani for cleaning the Rubens' ceiling	£2000	
1777	Barry for the paintings in the rooms of the Society of Arts after being fur- nished with colors received by the exhibition, £503 2s		

The practice of fresco painting will be found to produce strong sensations both in the artist and the public, and they will discover hidden beauties at present scarcely known to exist; it will draw the attention of the painter to works of art hitherto glanced at as being out of his style—the Elgin marbles will become properly appreciated, he will disseminate the admiration to his pupils, and through them the public will have their eyes opened to the riches they possess in those inestimable treasures of art.

It is objected that fresco painting cannot be removed like oil. I beg to refer to those painted by Paul Veronese, and brought to this country a few years since. It may be done on slate. I do not insist that fresco is either better than oil or encaustic, or that it is more effective, except for particular purposes, but it has advantages over every other style; it can be done in less time for less cost, and produce a larger income to the artist; it is certain of raising the arts as well as the taste of the manufactures, consequently must increase the revenue of the country.

CHEMICAL EQUIVALENTS.

(Resumed from page 4, and concluded.)

TABLES of the combining quantities of all chemical agents have been drawn up and arranged to guide the chemist in experimental researches. The utility of these tables is very extensive. Through their aid, and by remembering the proportional numbers of a few elementary substances, the composition of a great number of compound bodies may be calculated with facility. By knowing that 6 is the combining proportion of carbon, and 8 of oxygen, it is easy to recollect the composition of carbonic oxide and carbonic acid, the first being 6 carbon + 8 oxygen, and the second 6 carbon + 16 oxygen. 40 is the number of potassium, and potash, being its protoxide, is composed of 40 potassium + 8 oxygen. From these few data, we know at once the composition of the carbonate and bicarbonate of potash. The first is 22 carbonic acid + 48 potash; the second, 44 carbonic acid + 48 potash.

These tables are rendered still more useful, if accompanied by a logometric sliding scale, the application of which to this purpose was a happy invention of Doctor Wollaston. As it is not possible to include, on a single scale, the names of all substances, those are selected which are the most frequent subjects of reference. These are arranged in the order of their relative weights, and at such distances from each other, according to their weights, that the series of numbers, placed on a sliding scale, can at pleasure be moved, so that any number expressing the weight of a compound may be brought to correspond with the place of that compound in the adjacent column. The arrangement is then such that the weight of any ingredient in its composition, of any re-agent to be employed, or precipitate that might be obtained in its analysis, will be found opposite the point at which its respective name is placed. Let us illustrate its use by a few examples.

1. The quantity of any substance, which is equivalent to a given quantity of any other inscribed on the scale, may be learned by inspection; the quantities taken being quite arbitrary, and such as are liable to suit the purpose at any time. Thus, by bringing 50, on the slider (in a scale where the weight of hydrogen is expressed by 1), opposite to magnesia, or to its equivalent, 20, it will be seen that 50 parts of that earth are equivalent to 70 lime, 120 potash, &c.

2. It ascertains the quantity of each base that is equivalent to a given quantity of any acid. Thus 50 on the slider being brought opposite to sulphuric acid, or to its equivalent, 40, it appears that 50 parts of this acid saturate 25 of magnesia, 35 lime, 60 potash, &c. In a similar manner, it is capable of indicating the quantities of different acids required to saturate each base; thus 50 parts of magnesia saturate 100 of sulphuric acid, 135 nitric acid, &c.

3. It enables us to determine, by inspection, the proportions of the components in a given quantity of any substance of known composition. Thus, by bringing 100, on the slider, opposite to 72, the equivalent of dry sulphate of soda, we find 55.5 on the slider, opposite to the equivalent of sulphuric acid, and 44.5 opposite to the equivalent of soda; numbers which, together, make up 100 of the salt. It expresses not only the proximate, but the ultimate elements of compounds. Thus, keeping the slider in the same situation as above, we find 22.4 on the slider, opposite to 16, the equivalent of sulphur, and 33.1 opposite to 24, the equivalent of three proportions of oxygen; and 22.4×33.1 make up, together,

55.5 of sulphuric acid. By reference to the equivalents of sodium and oxygen, we find also that 44 parts of soda are made up of 33 sodium and 11 oxygen.

4. The quantity of any substance required to decompose a given quantity of another, by simple elective attraction, is at once taught by the scale. Thus, if we wish to know the smallest quantity of sulphuric acid adequate to decompose 100 parts of chloride of sodium, by bringing 100, on the slider, opposite to chloride of sodium, or its equivalent 60, we find 66½, on the slider, opposite to 40, the equivalent of dry sulphuric acid; and opposite to 49, the equivalent of sulphuric acid of commerce, we find 81½ of the latter. We must, therefore, employ 66½ of the former, or 81½ of the latter. Again, to know the quantity of dry sulphate of soda which would result if all the common salt were decomposed, we shall find 120, on the slider, opposite to the dry sulphate, or to its equivalent, 72, and 270 opposite to the crystallized sulphate, or to its representative number, 162.

5. The quantities of salts, each consisting of two ingredients, that are required for mutual decomposition, may be learned by a similar use of the sliding scale. Supposing, for instance, that we have 83 parts of sulphate of potash, and wish to know the quantity of chloride of barium required for their decomposition; bring 83, on the slider, opposite to sulphate of potash, or to 88, its representative, and opposite to 106, the equivalent of chloride of barium; we find 100 on the slider, which is the number required. The results of this decomposition may also be learned by examining the instrument when in the same situation of the slider, for opposite to the equivalent of sulphate of barytes, 118, we find on the slider 111, and opposite to chloride of potassium we find 71.5 on the slider, the two last numbers indicating the resulting quantities of the new compounds. Again, from the weight of a precipitate, it is easy to deduce the quantities of salts which have afforded it. Thus, if we had obtained by experiment 120 parts of dry sulphate of barytes, on bringing that number opposite to its equivalent, 118, we see at once that they may have resulted from 89½ of sulphate of potash, and 108 of chloride of barium; and, moreover, that 120 parts of barytic sulphate are composed of 40.6 sulphuric acid, and 79.4 barytes; the sulphuric acid consisting of 16.5 sulphur and 24.1 oxygen, and the barytes of 8.15 oxygen and 71.25 barium.

Other applications still, of the scale of chemical equivalents, are pointed out by Doctor Wollaston in his memoir, explanative of its principle and uses, in the Phil. Trans. for 1814; but the accurate and ready solution of so many important practical problems as have been noticed above are sufficient to show its importance to the chemist. Doctor Ure remarks of it, that it is "an instrument which has contributed more to facilitate the general study and practice of chemistry than any other invention of man."

ON THE LIGHT APPARENT DURING CRYSTALLIZATION.

M. H. Rosé has published an extremely interesting paper upon this subject in the *Comptes Rendus de l'Académie de Berlin*. A long time ago he discovered, and gave account of the fact, that when arsenious acid, in its vitreous state, was dissolved in hydrochloric acid hot, light was evolved, as each crystal formed on the cooling of the solution: and

from the whole of his experiments at that time, (*Annales de Chim. et Phys.*, lxi. p. 288), he concluded, that the production of light depended on the passage of the arsenious acid from the vitreous to the opaque condition.

The observations that have been from time to time made on the light of crystallization, have been of a desultory and incomplete character, owing to the circumstance that the phenomenon was an accidental one, and could not be re-produced at will. Thus it has been remarked by various authors, that sulphate of potass evolved light in crystallizing. Rose made many fruitless attempts to re-produce the phenomenon, but could not succeed with pure sulphate of potass, either crystallizing from solution or from fusion. He found, however, that in fusing together equal atomic weights of sulphate of potass and sulphate of soda, he obtained a mass not crystalline, like the former, but vitreous; and on dissolving this in boiling water, filtering rapidly, and placing it in the dark to crystallize, brilliant scintillations were produced, like those in the case of arsenious acid. When these crystals were re-dissolved, and again crystallized, no fresh scintillations resulted. The crystals obtained with light are phosphorescent on pressure, and one of the ordinary forms of sulphate of potass. The fused vitreous mass of double salt must be dissolved within a few hours of its fusion; otherwise internal crystallization takes place, and the light is not evolved on solution, &c. The crystals, which form a solution, although in the shape of sulphate of potass, are a double sulphate of potass and soda. The memoir contains, after giving their constitution, some very interesting observations on the parts which the soda-salt plays during their joint crystallization. M. Rose has also ascertained strictly analogous facts, with regard to double salts, composed of sulphate and chromate of potass and soda, and of seleniate of potass and soda, all of which are isomorphous: he finds the presence of the soda-salt essential to the phenomena. Finally, he concludes that the luminous appearances occurring during the crystallization of salts, are due to their passage from one isomeric state to another, a conclusion which these experiments, so far as they go, undoubtedly sustain; and hence, the first resemblance of a law connecting this curious class of phenomena is due to M. Rose. There are, however, some other observed cases of light given out during crystallization, which, although they may, on future examination, be found reducible to this law, are not so at present. Thus, M. Scanlan observed brilliant and continued flashes of light during the crystallization of nitrate of strontian, a fact not before observed (nor published) previous to the present notice.

COMPOSITION OF THE ATMOSPHERE.

THE last year has been marked by several rich contributions to our knowledge upon this important and difficult subject. Dumas and Boussingault, in conjunction with M. Brunner, have analyzed the atmosphere of various localities by new and rigidly exact methods. Their researches are too lengthened and important to admit of expression by a mere extract, but their conclusions may just be stated, and appear worthy of complete reliance.

Their researches correct the errors committed, as to the density of oxygen compared with that of

azote, and fix the density at ≈ 1.1057 , and that of azote at ≈ 0.972 . They show that air cannot be regarded as a chemical compound of 20 volumes of oxygen and 80 volumes of azote; but they indicate that the atmosphere is a mixture uniformly composed at every epoch, at every latitude, and at all heights, of 2301, by weight of oxygen, and 7699, by weight, of azote; or by volume of 20.81, oxygen, and 79.19, azote. They demonstrate that if it be true that plants are destined, by the action of their green parts in the sun's light, to destroy the carbonic-acid given off by animals, yet that their intervention is not necessary, since under the most unfavorable suppositions, not less than 800,000 years would have elapsed, before the whole mass of the atmosphere could be deprived of oxygen, by all the animals living upon its surface, from which it follows, that the atmosphere, considered as a reservoir of oxygen for animals, and of carbonic acid for plants, is a magazine so vast, that the expenditure of both, although in no way compensated, would be still inappreciable after the lapse of ages.

From hence, also, it follows, to have the least chance of rendering any variation in the mean proportions of oxygen and azote appreciable, would require analyses to be made with apparatus capable of operating upon about a kilograme and a half of air = 3.307 lbs. avoirdupois. The methods of investigation, some of which are entirely due to M. Brunner, and were published by him some years since in *Poggendorff's Annalen*, are extremely beautiful.

Amongst our own countrymen we have recently had examinations of air from the Cornish mines by M. Moyle, and that from the pestilential regions of the tropics by Professor Daniell. The latter gentleman has been the first in this country to place in a palpable view the influence of sulphuretted hydrogen in producing disease. But, M. Savi, of Pisa, an Italian savant, it appears, read to the meeting of the scientific Congress, held at Pisa, in October, 1839, a paper on the causes of malaria in certain parts of Italy, in which he then proposed the evolution of this gas as the principal cause. It is now generally admitted, that the evolution of sulphuretted hydrogen in marshes, or at the mouths of tropical rivers, is due to the re-action of organic matter in certain stages of decay upon sulphates of earthy or metallic bases existing in the water, whether fresh or salt, but most usually the latter. In the valuable memoir of Prof. Daniell, published in the *Philosophical Magazine*, a claim is generally made by the author to the first origination of this theory of the formation of this gas; but he appears to have been independently anticipated by M. Savi, and, indeed, the same solution of the problem appears to have been given by several others, also previously. M. Mallet has shown his own views as to the source of the gas to have been the same, as published in the *Reports of the British Association* (1840); and similar conclusions were previously given by Berthier, and by Leibig. It is remarkable thus to find so many experiments arriving independently at the same results.

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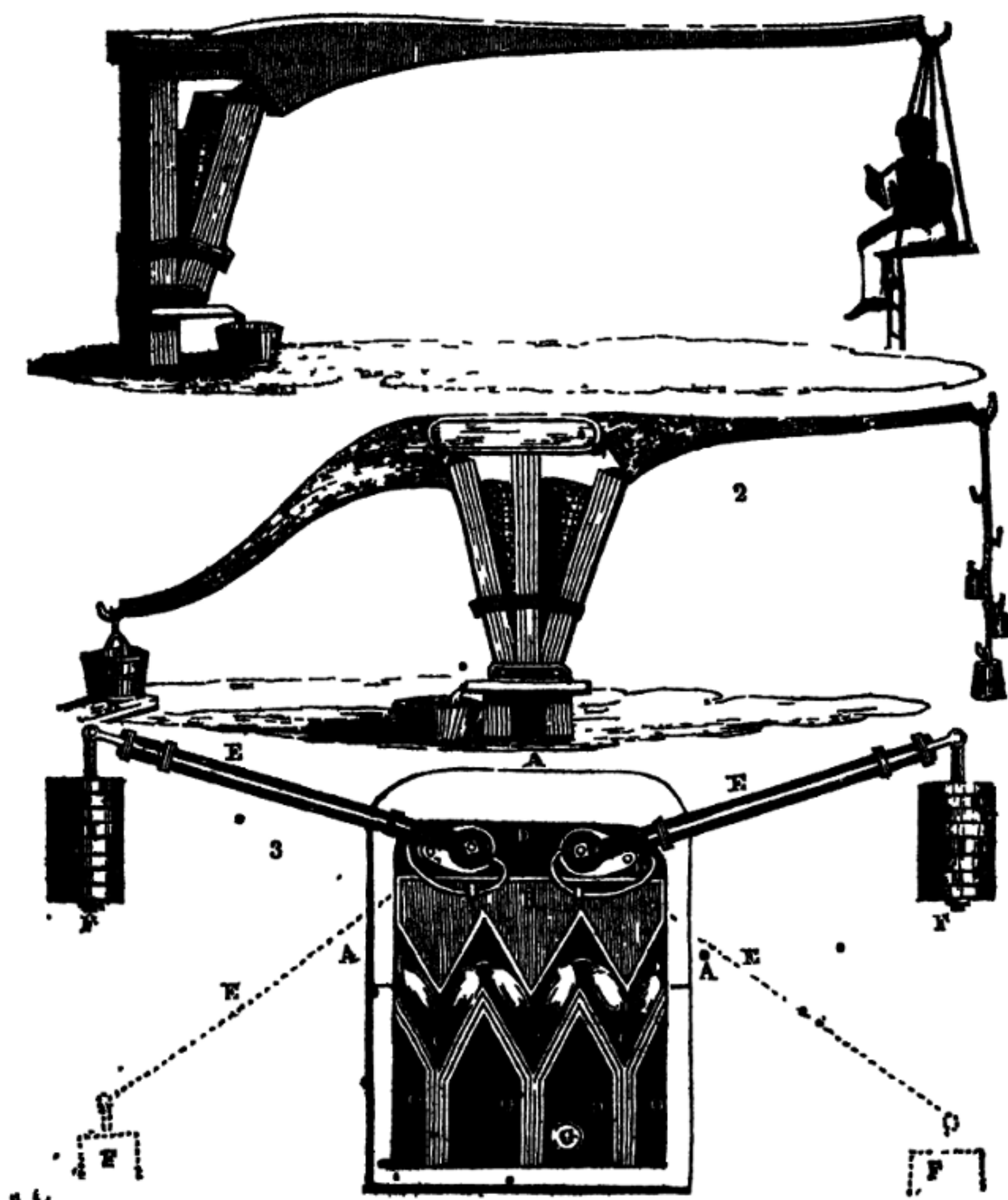
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[1d.]



OIL PRESSES.

OIL PRESSES.

THE great defect of ordinary presses is that the power diminishes as the material under pressure shrinks, thus they require constant attendance to screw them up. A few presses are without this inconvenience, but they are of comparatively little power, and adapted for such light purposes as the pressure of cheese, making of wine, &c. This remark, of course, does not apply to printing presses, which from their very nature, exert merely a momentary pressure, nor does it to Bramah's hydraulic press, which we described in the last volume. This continues its force with little diminution, notwithstanding the shrinking of the materials. But it is not every person who can afford to purchase this valuable but necessarily expensive article; yet a press of some kind is necessary to them. We have, therefore, devoted an article to a description of presses of an extraordinary character, but the principle of which is so excellent as to have obtained the unqualified and universal admiration of engineers. It is to be observed, that they are especially designed for the rural manufacture of oil on the spot where the seeds grow.

The first machine, Fig. 1, is a press used by the Singalese for the expression of cocoa nut oil. It consists simply of three pieces of wood; an upright piece is fixed firmly in the ground, (a tree would answer the purpose well,) near the lower end of which, and also at the upper extremity, are projecting pieces, the upper one forming the joint of the long horizontal lever, and the lower one the joint of the short vertical one; to strengthen these joints a strap of iron is laid over them, and round the upright post, and iron bolts are passed through each to form the centre, or fulcrum, to each lever; the band near the middle merely serves as a stay to support the vertical lever when it is thrown back. It will be observed, that a roller is fixed to the upper extremity of the vertical lever, which, running upon the inclined plane of the horizontal lever, renders the friction of these parts, when in contact, very trifling: but what we consider as the most important result of this peculiar combination of two levers (which are both of the second class) is, that the effect of the power employed is but little at the commencement of the operation, but that the pressure is continually increasing during the operation, and becomes prodigiously great towards the close of it, which is owing to the pressure on the vertical lever constantly accumulating (of itself without attention) as it approaches the fulcrum of the horizontal lever. Now this is precisely what is wanting in oil or wine-pressing: if a great pressure be given at the first, the bags burst and the liquid is lost. It is obvious, from the sketch, that the Indian who is seated in a swing, suspended to the lever, is the acting force; and as this force is obtained not only without labour, but by rest to the individual, there cannot be an easier mode of producing a mechanical effect, especially as some attendance to the process going forward is necessary. A shoemaker, or a tailor, might, indeed, carry on the business of their crafts, and at the same time, work an oil or a wine-press upon the same principle. The design having been made with reference to the conical bags employed in India for the purpose, will account for this peculiarity in the drawing, as well as in the subjoined modification of the machine, which is merely an extension of the principle to the forming of a double press. By this arrangement double the effect is produced at about half the additional cost of one

press; and if both presses were worked together (which might always be the case) instead of the central post being fixed in the ground, it might be put on a moveable stand, as the weight or force of one press would counterbalance that of the other. This figure (2) likewise shows two convenient modes of working the press with very little attention. To one of the horizontal levers a rope is suspended, having hooks at convenient distances, upon which such weights may be hung as may be found necessary to give the required pressure; to the other is suspended a bucket (the capacity of which would be regulated by the circumstances), to take advantage of a descending current of water (if the locality admits of it), or of a reservoir, or supply pipe, that might be raised to a proper elevation for filling it; when the operation is completed, as represented on one side of the press, the bucket falling against a tail-piece fixed upright in a channel or gutter, opens a valve, lets all the water out of the bucket, and relieves the press from the force of its weight. Thus in a situation where water is plentiful, a number of large presses, charged with the necessary materials for obtaining oil, or wine-juice, might be filled overnight; the next morning the buckets would be found discharged of their water, and the previously empty recipients be found filled with oil without any attendance whatever. It is, perhaps, deserving of notice, that the self-acting property of these presses adapts them for situations where advantage could be taken of the ebbing and flowing of the tide; the rising of the water would thus fill the buckets, and, upon its falling, leave them suspended with their loads to do the work of the press; the return of the tide would take off the pressure for the renewal of it upon its descent; and thus, every twelve hours, the presses might be worked with almost unlimited power and without any attendance to the moving force.

Fig. 3 gives a sectional view of a third and superior press, formed upon the same principle, excepting that the front plate which incloses the lower part of the machine, and the bearings of the axes of the cams are removed to show better the construction. A A A is a strong frame of cast iron (it may be of wood strongly bolted together); the size may be as circumstances may require; but a convenient size would be three feet high, two feet wide, and one foot from front to back. B is the pressing-head, of solid wood, formed into three wedge-shaped teeth, and made so as to fit into a bed C C C, of a corresponding figure; D D are two cams, firmly attached to expanding levers E E, which are loaded at their extremities by suspending thereto any required number of flat circular weights: to each of the cams a strong hook, bent to the figure of the former, is fixed; and these hooks passing through eyes, or staples, in the head of the press, lift it up when the pressure is taken off, allow it to descend without obstruction, and keep them always connected. At G is an aperture for conveying, by means of a pipe, hot air, or steam, into the chambers O O O, which have lateral openings one into the other; the angular roof of this chamber adapts it for collecting the heat, air, or vapour, whence it passes through the interposing iron plates into the bags under pressure. The bags being placed between the wedges as shown, the pressure is given by loading the levers (which may be drawn out to any length required,) which gradually causes them both to descend to the position shown by the dotted lines E E and F F; at which time the cams have turned a quarter round, so as to obtain a vertical position when their utmost

effect is produced. The bags between the wedges are thus compressed by a great force, and their contents reduced to hard dry cakes, while the expressed oil runs off in the angular gutters at the bottom, and is conducted out of the machine, by a pipe, into a proper recipient.

The operation being completed, the pressure is taken off by removing the weights (already close to the ground), and throwing up the levers which lift the head of the press, the chief labour of which may be obviated by a counter-balance weight. The oil cakes being taken out of the press, other bags, previously prepared, are put in their place, and the operation renewed simply by loading the levers, leaving them to do their work unassisted, and accumulate in power as they move through their assigned space. It should here be observed, that owing to an oversight in the drawing, the levers are not shown as fixed in the best position for commencing the operation. They should be placed slightly inclined from the vertical position; the power would then be considerably lessened at the beginning, and vastly increased towards the end. The extremities of the cams are furnished with strong anti-friction rollers, which come into action at the end of the process.

The action and power of this press may be described and estimated thus: the levers *EE* being fixed to the cams act with them as entire pieces, hence must be regarded as two bent levers, in which the points of pressure are constantly changing their position. Now supposing 5 cwt. appended to each lever, and each lever when drawn out to be ten feet long, and the pressure to be given at one inch from the fulcrum, this would give a power of 120 to 1, or 60 tons upon the head of the press. The head of the press, it will be observed, moves through a space, the treble of that which is between the opposite planes of the wedge-formed teeth, consequently, the power is here increased threefold, or raised to 180 tons; then, by applying similar levers and weights to the opposite ends of the axes of the cams, we have the force of 360 tons upon the goods in this little self-acting lever press. The friction in such a machine is undoubtedly considerable, but as any additional force within the limits of the strength of the structure may obviously be added, and the point of pressure be brought nearer to the fulcrum than the distance mentioned, at the close of the operation, any required power may be obtained at the period when it is wanted, to squeeze the cakes thoroughly dry. The oil-maker will do well to consider, that the force transmitted to the screw presses as well as by the hydrostatic is *intermittent*, and not a *constant self-accumulating force*, as exerted by the lever presses we have just described.

MAGNETISING POWER OF THE SOLAR RAYS.

DR. MORICHINI, more than twenty years ago, announced that the violet rays of the solar spectrum had the power of magnetising small steel needles that were entirely free of magnetism. This effect was produced by collecting the violet rays in the focus of a convex lens, and carrying the focus of these rays from the middle of one half of the needle to the extremities of that half, without touching the other half. When this operation had been performed for an hour, the needle had acquired perfect polarity. *M. Carpa* and *Ridolfi* repeated this experiment with perfect success; and Dr. Morichini magnetised several needles in the presence of Sir H. Davy, Prof

fessor Playfair, and other English philosophers. *M. Bérard* at Montpellier, *M. Dhombres Firmas* at Alais, and Professor *Configliachi* at Pavia, having failed in producing the same effects, a doubt was thus cast over the accuracy of preceding researches.

A few years ago, Dr. Morichini's experiment was restored to credit by some ingenious experiments by Mrs. Somerville. Having covered with paper half of a sewing needle, about an inch long, and devoid of magnetism, and exposed the other half uncovered to the violet rays, the needle acquired magnetism in about two hours, the exposed end exhibiting north polarity. The indigo rays produced nearly the same effect, and the blue and green produced it in a less degree. When the needle was exposed to the yellow, orange, red, or caloric rays beyond the red, it did not receive the slightest magnetism, although the exposures lasted for three days. Pieces of clock and watch springs gave similar results; and when the violet ray was concentrated with a lens, the needles, &c., were magnetised in a shorter time. The same effects were produced by exposing the needles, half covered with paper, to the sun's rays transmitted through glass colored blue with cobalt. Green glass produced the same effect. The light of the sun transmitted through blue and green riband produced the same effect as through colored glass. When the needles thus covered had hung a day in the sun's rays behind a pane of glass, their exposed ends were north poles, as formerly.

In repeating Mrs. Somerville's experiments, *M. Baumgartner* of Vienna discovered that a steel wire, some parts of which were polished, while the rest were without lustre, became magnetic by exposure to the white light of the sun; a north pole appearing at each polished part, and a south pole at each unpolished part. The effect was hastened by concentrating the solar rays upon the steel wire. In this way he obtained eight poles on a wire eight inches long. He was not able to magnetise needles perfectly oxidated, or perfectly polished, or having polished lines in the direction of their lengths.

About the same time, Mr. Christie of Woolwich found that when a magnetised needle, or a needle of copper or glass, vibrated by the force of torsion in the white light of the sun, the arch of vibration was more rapidly diminished in the sun's light than in the shade. The effect was greatest on the magnetised needle. Hence he concludes that the compound solar rays possess a very sensible magnetic influence.

These results have received a very remarkable confirmation from the experiments of *M. Barlocchi* and *M. Zantedeschi*. Professor Barlocchi found that armed natural loadstone, which could carry $1\frac{1}{2}$ Roman pounds, had its power nearly doubled by twenty-four hours' exposure to the strong light of the sun. *M. Zantedeschi* found that an artificial horse-shoe loadstone, which carried $13\frac{1}{2}$ oz., carried $3\frac{1}{2}$ more by three days' exposure, and at last supported 31 oz., by continuing it in the sun's light. He found, that while the strength increased in oxidated magnets, it diminished in those which were not oxidated, the diminution becoming insensible when the loadstone was highly polished. He now concentrated the solar rays upon the loadstone by means of a lens; and he found that, both in oxidated and polished magnets, they acquire strength when their north pole is exposed to the sun's rays, and lose strength when the south pole is exposed. He found likewise that the augmentation in the first case exceeded the diminution in the second. *M. Zantedeschi* repeated

the experiments of Mr. Christie on needles vibrating in the sun's light; and he found that, by exposing the north pole of a needle a foot long, the semi-amplitude of the last oscillation was 6° less than the first; while, by exposing the south pole, the last oscillation became greater than the first. M. Zantedeschi admits that he often encountered inexplicable anomalies in these experiments.

Decisive as these results seem to be in favor of the magnetising power both of violet and white light, yet a series of apparently very well conducted experiments have been lately published by MM. Riess and Moser, which cast a doubt over the researches of preceding philosophers. In these experiments, they examined the number of oscillations performed in a given time *before* and *after* the needle has submitted to the influence of the violet rays. A focus of violet light concentrated by a lens 1·2 inches in diameter, and 2·3 inches in focal length, was made to traverse one half of the needle 200 times; and though this experiment was repeated with different needles at different seasons of the year, and different hours of the day, yet the duration of a given number of oscillations was almost exactly the same after as before the experiment. Their attempts to verify the results of Baumgartner were equally fruitless; and they therefore consider themselves as entitled to reject totally a discovery, which for seventeen years has at different times disturbed science. "The small variations," they observe, "which are found in some of our experiments, cannot constitute a real action of the nature of that which was observed by MM. Morichini, Baumgartner, &c. in so clear and decided a manner."

REVIEW.

The Dictionary of Experiments, or Scientific and Mathematical Recreation; illustrated with many hundred Engravings. By the Author of the Dictionary of Arts and Sciences. Part 1, price 7d.—G. Berger, Holywell Street.

We would introduce the above work, of which the first part appeared on April 1, to the notice of our friends. The object proposed is, to illustrate the most valuable departments of science by means of experiments, arranging these in such order, as that the book, when complete, shall form a complete and systematic treatise upon each subject. *Chemistry* has been chosen for the commencement, on account of its importance; the ease with which its operations may be performed, the cheapness of its apparatus, and the peculiar brilliance and infinite variety of its experiments. The first part is chiefly introductory, treating of chemical operations and apparatus, trituration, combination, solution, precipitation, filtration, distillation, sublimation, crystallisation, &c.; a necessary division of the subject, and one which is most valuable to the young chemist. To show the manner in which the subject is treated, we will annex two short extracts, one from the chapter on crystallisation, and the other from that on solution.

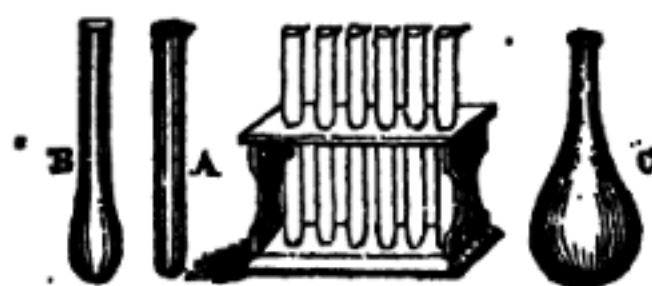
SOLUTION, INFUSION, AND DIGESTION.

"Dr. Faraday justly observes, that 'there are two great and general objects to be gained by solution, which renders it a process of constant occurrence in the laboratory. The first is that of preparing substances, for the exertion of chemical action; the second object is that of separating one substance from another; this being continually

effected by the use of such fluids as have a solvent power over one or more of the substances present.' Solution presents itself under three forms:—the solution of solids, liquids, and gases. The body in which any thing is dissolved is called the *solvent*, or *menstruum*; the body dissolved is said to be *soluble*, and is called a *base*; the mixture of the two is the *solution*. When the solvent has taken up as much as is possible of the soluble matter, we call the result a saturated solution. The degree of solubility in bodies is extremely varied, as well as the menstruum used to dissolve them; so that one material may be soluble in alcohol, or in oil, and not in water; or it may be soluble in water, and scarcely in any thing else; or it may dissolve in numerous solvents, or in none. For performing solutions it is necessary to be provided with several small rods of glass, and some glasses. The following forms are usually given to solution glasses:—



"But any others, such as wine glasses, will answer for the purpose of experiments with small quantities of materials. Watch glasses are excellent, and so are test tubes, which are small tubes of glass, from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch in diameter, and from 2 to 6 inches in length. In London these, and other glass chemical apparatus, may be bought very cheap of the Italian barometer makers, who live in Leather Lane and its neighbourhood. Below are represented several test tubes of different sizes. Observe to choose them of very thin glass.



"All these instruments are equally useful for evaporation and other chemical operations. Solution is usually much assisted by heat, pulverizing the base, and by trituration and stirring.

"*Ex. 73. Solution of Solids.*—Dissolve some common salt in common cold water, in a large tube; and put so much salt that a portion of it remains at the bottom of the tube. Suffer it to settle; pour off the clear liquor into another tube, and boil it over a lamp. It will now deposit some more of the salt; thus proving that cold water will dis-



solve more of this particular kind of salt than hot water. The salt deposited during the heating of the liquid will be re-dissolved as it cools. To preserve

the hand from the heat of the tube, and the vapour of the boiling liquid, the tube may be inserted in a large cork, or else supported by a wire, or held by a piece of paper twisted round it.

Note.—In dissolving the salt, small bubbles will be seen to arise from it. These are not the result of a chemical action, but merely air bubbles which are liberated as the salt dissolves.

"79. Boil a few fragments of gum mastic in a tube with alcohol under pressure, that is, closing the top of the tube with the finger, (the hand should be covered by a glove to prevent the heat of the tube from burning it, and to guard against the effects of explosion should the tube burst.)

This solution diluted with more alcohol, so as to diminish the quantity of mastic to 70 grains in half a pint, forms an excellent wash for fixing chalk and pencil drawings.



"80. To make phosphoric oil.—Dissolve 1 grain of phosphorus in a tea-spoonful of olive oil in a test tube, by means of the heat of a water bath. The phosphorus will dissolve but slowly; when it is dissolved the liquid must be kept in a well-corked phial. A few drops of the oil rubbed over the face, hands, or clothes, will appear quite luminous in the dark; and so also will be the contents of the bottle itself when uncorked.

Note.—A common glue pot is the most familiar instance of a water bath, and one may be used for numerous purposes of solution, slow evaporation, &c. For delicate purposes, like the above, a water bath may be made of a small test tube, inserted in a larger one—the latter being partly filled with water; and although oil, or other liquid, may be used instead of water in the outer tube, when a greater heat is required, yet it is still called a water bath. In thus making a water bath, the outer tube should be the shorter of the two, that the steam may not interfere with the solution tube.



CRYSTALLIZATION.

"Es. 174. Crystallization of alum.—Make a solution of common alum, and set it aside; the liquid will gradually evaporate, and minute crystals be deposited at the bottom of the vessel. These by degrees increase in number, and grow larger. The shape of them will be similar to those in the annexed cut; the smaller of them are usually the most perfect, and are regular octohedra, or eight-sided figures. This is called their primary form, but among these will be found some which are without edges or angles, or rather have their angles truncated; these forms are called secondary forms of the

crystal. The annexed cut shows the primary and secondary forms of the crystals of alum:

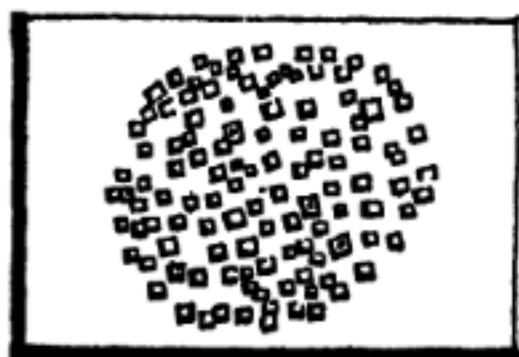


"180. To crystallize glass windows, and therefore to render them semi-opaque.—Make a hot saturated solution of Epsom salts, or still better, of sal-ammoniac. Wet the glass window with this solution, laid on equally with a paint brush. The moisture will almost instantly be evaporated, and the salt be deposited in a very beautiful radiated form. This deposition will admit the light, yet cannot be seen through; and for rendering windows semi-opaque is infinitely to be preferred to paint, paste, or other materials employed for this purpose.

"181. To form crystallized microscopic objects.—Wash over the surface of a slip of glass, a hot saturated solution of the required salt, as in the last experiment. It will crystallize in its normal and natural form, and present a most beautiful figure of crystallization, when examined by a pocket lens or a microscope. Sal ammoniac will give an aggregation of crystals of the foregoing character.



"182. Another method is to put a single drop of the solution on a slip of glass, and let it slowly or quickly evaporate; thus several specimens may be preserved on the same slip; if common salt be used, the crystals will assume a cubical form, as under.



"183. Instead of common salt, use Epsom salts, the crystals will be very beautiful, representing four-sided prisms, with flat ends.



"184. If either nitre or Glauber's salt be used in lieu of the above, the result will be six-sided prisms, with pointed ends. And to vary the experiment, a drop of the solution may be put upon a hot piece of

glass, and immediately placed under examination; when as the evaporation proceeds, the crystallization may be witnessed.



"A small quantity of blood or of skim milk added to the saline solution will materially alter the form of the crystals. Any other salts may thus be examined; among the most interesting are boracic acid, nitro-muriate of gold, corrosive sublimate, acetate of morphia, and of copper, Rochelle salt, prussiate of potash, sulphate of quinine, borax, sulphate of copper, antioduret of mercury, chloride of copper, nitrate of silver, chromate of potash, nitrate of nickel, phosphates of lead and of copper, sulphate of cobalt, and chlorate of potash."

It will ill become us to praise our own work, but surely we may be allowed to say, that if we had been fortunate enough to have had such a simple and interesting guide to chemistry when we were young, it would have saved us years of study, and many pounds of expense; so we have written such a work as is adapted to lead the student forward in his road to knowledge, by adopting easy language, giving plain instructions, and considering at all times his pocket. The apparatus necessary is of the cheapest description, and although in the introductory part, ingredients are presumed to be at hand, and to have been purchased by the experimentalist, yet in the progress of the work, instructions will be given to make, to purify, and to test every chemical substance whatever.

BRITISH QUADRUPEDS.

(Resumed from page 8, and concluded.)

THE ferret tribe comprehends the polecat, weasel, stoat or ermine, the common marten, and the pine marten.

The polecat (*Putorius vulgaris* Cuv.), called also the fitchet, fitchew, or foumart, measures, with the tail, about twenty-three inches. Its fetid smell is proverbial. Although included in the list of British quadrupeds, it appears, according to Strabo, to have been imported from the north of Africa. Like all its congeners, its habits are sanguinary; for it will destroy and suck the blood of many victims before it attempts to carry off their bodies. The well-known ferret is considered only a variety of this species. The weasel is much smaller, and although repulsive from its odour, is yet an elegant-shaped animal. It feeds on mice and small birds, but will occasionally attack animals of a much larger size. Few persons suspect that the skins they see nailed against farm out-houses frequently belong to an animal whose fur, in another state, forms a most elegant and expensive ornament to female dress. This animal, despised in one state, and valued in another, is the stoat, the pest of the farmer, and the destroyer of his poultry. In the temperate and southern parts of Europe, its fur is yellowish brown above, and pale

yellow beneath; yet so soon as its geographic range enters on the more northern countries, as Russia, Norway, and Siberia, these colors vanish, leaving the fur of a pure white in every part but the tail, which is tipped with deep black; and in this state the skin is called ermine. In Scotland the animal, during winter, is frequently found in an intermediate stage of summer and winter clothing. Although small, it will attack large rats, and has been known to pursue a young hare by the scent.

The common beech or marten (*M. Fagorum* Ray) seems to prefer dwelling near habitations, choosing the shelter of out-houses and farm-buildings, as convenient retreats for carrying on its depredations among poultry, of which it is a great devourer; it also breeds occasionally in the hollows of trees.

The pine marten (*M. Abietum* Ray,) is rather larger, and is further distinguished from the last in having the throat and breast yellow, instead of white. It is wild and solitary; shunning mankind; and only dwells in thick woods and forests, principally those composed of pines. It climbs with great facility; preys upon birds and their eggs, and also upon squirrels; the female generally making use of the nest of one of her victims for the rearing of her own young. The skin of this is much more prized than that of the common marten, and appears to have been formerly, at least in Scotland, a lucrative article of commerce.

The wild cat closes our list of these small but ferocious indigenous animals. Its manners are similar to those of the lynx, and Mr. Pennant justly calls it the British tiger. In its savage state it appears to be much larger than the ordinary domestic cat; and the teeth and claws, for the size of the animal, are tremendous. It is still found, although rarely, in the mountainous and woody parts of Great Britain, and some few years ago we saw a very fine skin of one that had been killed among the mountains of Westmoreland, near Windermere. Formerly they appear to have been considered a beast of chase. The best authorities agree in considering this species, common to the forests of Europe, as the origin of our domestic breed, the usual varieties of which are well known. Another, which seems more peculiar to Cornwall, has been noticed by Dr. Leach: it is without any visible tail, and is stated to be an hereditary variety. (Cuv. ii. 489.)

To enumerate the varieties of the dog now domesticated in Britain would be tedious, particularly after the luminous manner in which this subject has been treated by Pennant (*Brit. Zool.* i. 70). Britain has been famous for her dogs from remote antiquity. Our mastiffs were held in such estimation by the Romans, that their emperors appointed an officer in this island, with the name of *Procurator Cynegii*, whose sole business was to breed and transmit from hence such as would prove equal to the ferocious combats of the amphitheatre. Strabo also mentions that the mastiffs of Britain were in great repute, trained for war, and used by the Gauls in their battles.

The bloodhound, during the troubled periods of English history, was in high estimation, and much used to track the footsteps of robbers and marauders; but the breed is now extinct. A remarkable variety of the greyhound, more peculiar to Ireland, (hence called the Irish greyhound or wolf dog), is nearly lost, a few couples alone having been preserved in one of the parks in that island. The terrier is the best house guard; while the shepherd, the water,

and the Newfoundland dogs are probably the most sagacious.

Of ruminating animals now existing with us in a state of nature, there are but three; the stag or red deer, the fallow deer, and the roebuck. It would appear, however, that the first two are not indigenous to our islands, Mr. Pennant writes—"We have two varieties of fallow deer, which are said to be of foreign origin: these were introduced by King James I. out of Norway, which he visited for his intended bride, Anne of Denmark. He first brought some into Scotland, and from thence transported them to his chaces of Enfield and Epping, to be near his palace of Theobald's." The only memorial of this palace is probably preserved in the name of Theobald's Road. M. Cuvier, indeed, expresses a doubt whether the stag was originally European; but Major Hamilton Smith, with much better reason, considers the fallow deer (*Cervus Dama*) as indigenous to Europe; adding, that it is still found wild from Sweden to Gibraltar, and from Ireland to Constantinople. The stag (*Cervus Elaphus*) seems to be unquestioned as an indigenous species; and although the wild breed is yearly diminishing in numbers, it is still found in Gloucestershire, the north-west parts of Devon, and in some of the remote districts of Scotland. Pennant, by some unaccountable mistake, has placed the stag and the fallow deer as varieties of one species.

The roebuck (*Cervus capreolus* Ham. Smith) is much less than the two preceding, and is, indeed, the smallest of European deer. It is remarkably graceful and active, habitually preferring the sides of elevated woods or forests. As he leaves a strong scent, nature has given him peculiar sagacity to perplex his pursuers; he begins, after a forward dash, by doubling over his track to mislead the hounds, and then by some great bounds he springs forward to a cover, where he lies down to let the chase pass. The roebuck is now become very scarce in Britain, and was equally so in Scotland, but we are told it has reappeared of late years in Fifeshire, in consequence of the increased plantations. (*Brit. An.* p. 26.)

The ox is the only remaining animal of this order which claims a place among our indigenous quadrupeds. We have before observed, that in remote ages, a gigantic race of oxen was numerous throughout Europe; and that, although now extinct, there is reason to believe that the colossal species mentioned by Cæsar, as existing in his time, was of this race, now only known by its fossil bones. These remains lay scattered through the whole of temperate Europe, in the same strata with the lost species of elephant; but that the race was preserved to a much later period is proved by similar bones occurring in more recent formations, as in peat mosses, drained lakes, marshes, and beds of sand. The wild races, of inferior size, belonging to this species, may probably, as Major Smith observes, even now exist in Asia. However this may be, it appears certain that the real *Urus* was found wild in the Vosges mountains, and in the forests of Ardennes and Germany; while its existence in England is incontestably proved by Fitz-Stephen, who speaks of the *Uri sifoesires*, which in his time (that is, about 1150) infested the great forests round London.

The only existing breed of wild oxen now known, is the white *urus*, or *Urus scoticus* of Ham. Smith. Its skull agrees with the fossil breed in being "square from the orbits to the occipital crest,

somewhat hollow at the forehead, and the horns showing a peculiar rise from their root, at the side of the above crest, upwards, and then bending outwards, then forward and inward: no domestic race shows this turn." The true *urus* was further distinguished by a mane which is still observed about two inches long, in old bulls of the Scottish race. When this breed was exterminated from the open forest is not known; but it was confined to parks long before the reformation. The color is entirely white, with the muzzle wholly black. Their manners are singular: upon perceiving a stranger, they gallop wildly in a circle round him, stop and gaze, toss their heads, and show signs of defiance; this is repeated several times, each circle being made smaller, till they approach sufficiently near to make an effective charge. The cows conceal their young eight or ten days; and when one of the herd is wounded or enfeebled, the others gore it to death. The breed is still preserved at Chillingham Castle, near Berwick-upon-Tweed, Wollaston in Nottingham, Gilsburne in Craven, Limehall in Cheshire, and at Chartley in Staffordshire.

The domestic ox (*bos taurus*), considered by some as a variety, and by others as a distinct species from the last, is supposed by Hamilton Smith to have been first domesticated by the Caucasian nations of Western Asia. It is stated to have fourteen ribs, whereas those of the *B. urus* are but twelve; a distinction sufficiently important to sanction the belief of a specific difference. Whether or not this parent of our domestic races ever existed in these islands in a state of nature, is very doubtful.

ANALYSIS OF THE ASHES OF PLANTS.

THE analysis of the ashes of plants, with a view to the discovery of the ingredients of which they are composed, produces alkalies, earths, and metals, which must therefore be considered as ingredients in the composition of the vegetable. But vegetable ashes contain also a variety of other principles, occurring, however, in such small proportions as generally to escape observation. Perhaps they contain also substances not capable of being volatilised by the action of fire.

Alkalies.—The alkalies are a peculiar class of substances, distinguished by a caustic taste and the property of changing vegetable blues to green. They are generally regarded as being three in number, potass, soda, and ammonia, of which the two former only are found in the ashes of vegetables. Ammonia is, indeed, often obtained from vegetable substances by means of distillation, but then it is always formed during the process. If the ashes of land vegetables, burnt in the open air, are repeatedly washed in water, and the water filtered and evaporated to dryness, potass is left behind. The potass of commerce is manufactured in this manner, though it is not quite pure: but it may be purified by dissolving it in spirits of wine, and evaporating the solution to dryness in a silver vessel. When pure it is white and semi-transparent, and is extremely caustic and deliquescent. It dissolves all soft animal substances, and changes vegetable blues into green. It dissolves alumina, and also a small quantity of silice, with which it fuses into glass by the aid of fire. It had been long suspected by chemists to be a compound substance: and according to the notable discovery by Sir H. Davy, the component parts are at last ascertained to be oxygen and a highly inflam-

soluble matter, which he denominates potassium; one proportion of each. Soda is found chiefly in marine plants, from the ashes of which it is obtained by means of filtration. It exists in great abundance in *Salsola soda*, *Zostera maritima*, and various species of *Fuci*. It is generally obtained in the state of a carbonate, but is purified in the same manner as potash, to which it is similar in its properties; but from which it is easily distinguished by its forming a hard soap with oil, while potash forms a soft soap. It consists, according to Sir H. Davy, of one proportion of a metal which he denominates sodium, and two proportions of oxygen. Such are the only vegetable alkalies, and the modes of obtaining them. They are found generally in the state of carbonates, sulphates, or muriates, salts which form, beyond all comparison, the most abundant ingredient in the ashes of green herbaceous plants whose parts are in a state of vegetation. The ashes of the golden rod, growing in an uncultivated soil, and of the bean, turnsole, and wheat, were found by Saussure to contain at least three fourths of their weight of alkaline salts. This was nearly the case also with the leaves of trees just bursting from the bud. But the proportion of alkaline salts is found to diminish, rather than to augment, as the parts of the plant are developed. The ashes of the leaves of the oak, gathered in May, yielded 47 parts in the 100 of alkaline salts; and in September only 17.

Earths.—The only earths which have hitherto been found in plants are the following: lime, silica, magnesia, and alumina.

Lime is by far the most abundant earth. It is generally combined with a portion of phosphoric, carbonic, or sulphuric acid, forming phosphates, or carbonates, or sulphates of lime. The phosphate of lime is, next to the alkaline salt, the most abundant ingredient in the ashes of green herbaceous plants whose parts are all in a state of vegetation. The leaf of a tree, bursting from the bud, contains in its ashes a greater portion of earthy phosphate than at any other period; 100 parts of the ashes of the leaves of the oak, gathered in May, furnished 24 parts of earthy phosphate; in September, only 18.25. In annual plants the proportion of earthy phosphate diminishes from the period of their germination to that of their flowering. Plants of the bean, before flowering, gave 14.5 parts of earthy phosphate; in flower, only 13.5. Carbonate of lime is, next to phosphate of lime, the most abundant of the earthy salts that are found in vegetables. But if the leaves of plants are washed in water the proportion of carbonate is augmented. This is owing to the subtraction of their alkaline salts and phosphates in a greater proportion than their lime. In green herbaceous plants whose parts are in a state of increase, there is but little carbonate of lime; but the ashes of the bark of trees contain an enormous quantity of carbonate of lime, and much more than the alburnum, as do also the ashes of the wood. The ashes of most seeds contain no carbonate of lime; but they abound in phosphate of potash. Hence the ashes of plants, at the period of the maturity of the fruit, yields less carbonate of lime than at any previous period.

Silica is not found to exist in a great proportion in the ashes of vegetables, unless they have been previously deprived of their salts and phosphates by washing; but, when the plants are washed in water, the proportion of their silica augments. The ashes of the leaves of the hazel, gathered in May, yielded

2.5 parts of silica in 100. The same leaves, washed, yielded four parts in 100. Young plants, just bursting from the bud, contain but little silica in their ashes; but the proportion of silica augments as the parts are developed. Perhaps this is owing to the diminution of the alkaline salts. The ashes of some stalks of wheat gathered a month before the time of flowering, and having some of the radical leaves withered, contained 12 parts of silica and 65 of alkaline salts in 100. At the period of their flowering, and when more of their leaves were withered, the ashes contained 32 parts of silica and 54 of alkaline salts. Seeds divested of their external covering, contain less silica than the stem furnished with its leaves; and it is somewhat remarkable, that there are trees of which the bark, alburnum, and wood contain scarcely any silica, and the leaves a great deal, particularly in autumn. The greater part of the grasses contain a very considerable proportion of silica, as do also the plants of the genus *Equisetum*. Sir H. Davy has discovered that it forms a part of the epidermis of these plants, and in some of them the principal part. From 100 parts of the epidermis of the following plants the proportions of silica were, in bonnet cane, 90; bamboo, 71.4; common reed, 48.1; stalks of corn, 66.5. Owing to the silica contained in the epidermis, the plants in which it is found are sometimes used to give a polish to the surface of substances where smoothness is required. The Dutch rush (*Equisetum hyemale*), a plant of this kind, is used to polish even brass.

Magnesia does not exist so abundantly in the vegetable kingdom, as the two preceding earths. It has been found, however, in several of the marine plants, particularly the *Fuci*; but *Salsola soda* contains more of magnesia than any other plant yet examined. According to Vanquelin, 100 parts of it contain 17.929 of magnesia.

Alumina has been detected in several plants, but never except in very small quantities.

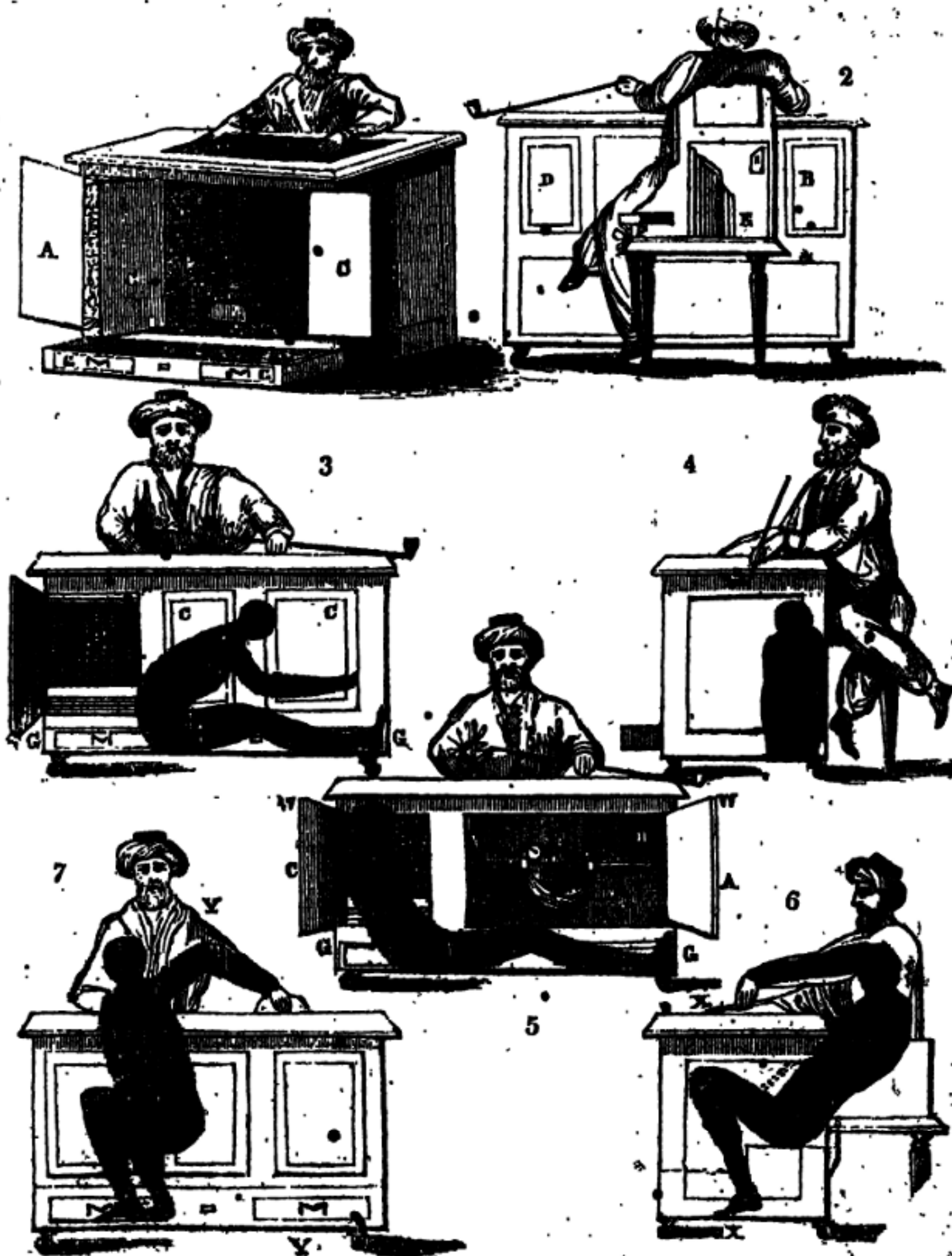
Metallic oxides.—Amongst the substances found in the ashes of vegetables, we must class also metals. They occur, however, only in small quantities, and are not to be detected except by the most delicate experiments. The metals hitherto discovered in plants are iron, manganese, and perhaps gold. Of these iron is by far the most common. It occurs in the state of an oxide; and the ashes of hard and woody plants, such as the oak, are said to contain nearly one-twelfth of their own weight of this oxide. The ashes of *Salsola* contain also a considerable quantity. The oxide of manganese was first detected in the ashes of vegetables by Scheele, and afterwards found by Proust in the ashes of the pine, calendula, vine, green oak, and fig-tree. Beccher, Kunckel, and Sage, together with some other chemists, contend also for the existence of gold in the ashes of certain plants; but the very minute portion which they found, seems more likely to have proceeded from the lead employed in the process, than from the ashes of the plant. It has been observed by Saussure, that the proportion of the oxides of iron and of manganese augments in the ashes of plants as their vegetation advances. The leaves of trees furnish more of these principles in autumn than in spring, as do those of annual plants. Seeds contain metals in less abundance than the plants; and if plants are washed in water, the proportions of their metallic oxides are augmented.

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THE AUTOMATON CHESS-PLAYER.

THE AUTOMATON CHESS-PLAYER.

MANE of our readers may remember, or at least have heard of the automaton chess-player, which was exhibited in London some years ago, and which at that time occasioned to the whole country the greatest astonishment. We have often been requested to give an account of this wonderful machine, and in furtherance of this request, we give the best illustrations which have been published relative to it, and with several cuts to elucidate the remarks upon the subject.

"In the year 1769, M. Kempelen, a gentleman of Presburg in Hungary, constructed an automaton chess-player, the general appearance of which is shown in the annexed figures. The chess-player is a figure as large as life, clothed in a Turkish dress, sitting behind a large square chest or box, three feet and a half long, two feet deep, and two and a half high. The machine runs on castors, and is either seen on the floor when the doors of the apartment are thrown open, or is wheeled into the room previous to the commencement of the exhibition. The Turkish chess-player sits on a chair fixed to the square chest: his right arm rests on the table, and in the left he holds a pipe, which is removed during the game, as it is with this hand that he makes the moves. A chess-board, eighteen inches square, and bearing the usual number of pieces, is placed before the figure. The exhibitor then announces to the spectators his intention of showing them the mechanism of the automaton. For this purpose he unlocks the door A, Fig. 1, and exposes to view a small cupboard lined with dark colored cloth, and containing cylinders, levers, wheels, pinions, and different pieces of machinery, which have the appearance of occupying the whole space. He next opens the door B, Fig. 2, at the back of the same cupboard, and holding a lighted candle at the opening, he still further displays the inclosed machinery to the spectators, placed in front of A, Fig. 1. When the candle is withdrawn, the door B is then locked; and the exhibitor proceeds to open the drawer GG, Fig. 1, in front of the chest. Out of this drawer he takes a small box of counters, a set of chess-men, and a cushion for the support of the automaton's arm, as if this were the sole object of the drawer. The two front doors CC, of the large cupboard, Fig. 1, are then opened, and at the back-door D of the same cupboard, Fig. 2, the exhibitor applies a lighted candle, as before, for the purpose of showing its interior, which is lined with dark cloth like the other, and contains only a few pieces of machinery. The chest is now wheeled round, as in Fig. 2; the garments of the figure are lifted up, and the door E in the trunk, and another door F, in the thigh, are opened; the doors B and D having been previously closed. When this exhibition of the interior of the machine is over, the chest is wheeled back into its original position on the floor. The doors A, C, C, in front, and the drawer G, G, are closed and locked, and the exhibitor, after occupying himself for some time at the back of the chest, as if he were adjusting the mechanism, removes the pipe from the hand of the figure, and winds up the machinery.

"The automaton is now ready to play, and when an opponent has been found among the company, the figure takes the first move. At every move made by the automaton, the wheels of the machine are heard in action; the figure moves its head, and seems to look over every part of the chess-board.

When it gives check to its opponent, it shakes its head thrice, and only twice when it checks the queen. It likewise shakes its head when a false move is made, replaces the adversary's piece on the square from which it was taken, and takes the next move itself. In general, though not always, the automaton wins the game.

"During the progress of the game, the exhibitor often stands near the machine, and winds it up like a clock, after it has made ten or twelve moves. At other times he went to a corner of the room, as if it were to consult a small square box, which stood open for this purpose.

"The chess-playing machine, as thus described, was exhibited after its completion in Presburg, Vienna, and Paris, to thousands, and 1783 and 1784 it was exhibited in London and different parts of England, without the secret of its movements having been discovered. Its ingenious inventor, who was a gentleman and a man of education, never pretended that the automaton itself really played the game. On the contrary, he distinctly stated, 'that the machine was a *bagatelle*, which was not without merit in point of mechanism, but that the effects of it appeared so marvellous only from the boldness of the conception, and the fortunate choice of the methods adopted for promoting the illusion.'

"Upon considering the operations of this automaton, it must have been obvious that the game of chess was performed either by a person inclosed in the chest, or by the exhibitor himself. The first of these hypotheses was ingeniously excluded by the display of the interior of the machine, for as every part contained more or less machinery, the spectator invariably concluded that the smallest dwarf could not be accommodated within, and this idea was strengthened by the circumstance, that no person of this description could be discovered in the suite of the exhibitor. Hence the conclusion was drawn, that the exhibitor actuated the machine either by mechanical means conveyed through its feet, or by a magnet concealed in the body of the exhibitor. That mechanical communication was not formed between the exhibitor and the figure, was obvious from the fact, that no such communication was visible, and that it was not necessary to place the machine on any particular part of the floor. Hence the opinion became very prevalent that the agent was a magnet; but even this supposition was excluded, for the exhibitor allowed a strong and well-armed loadstone to be placed upon the machine during the progress of the game. Had the moving power been a magnet, the whole action of the machine would have been deranged by the approximation of a loadstone concealed in the pockets of any of the spectators.

"As Baron Kempelen himself had admitted that there was an illusion connected with the performance of the automaton, various persons resumed the original conjecture, that it was actuated by a person concealed in its interior, who either played the game of chess himself, or performed the moves which the exhibitor indicated by signals. A Mr. J. F. Freyherr, of Dresden, published a book on the subject in 1789, in which he endeavoured to explain, by colored plates, how the effect was produced; and he concluded, 'that a well-taught boy, very thin and tall of his age, (sufficiently so that he could be concealed in a drawer almost immediately under the chess-board,) agitated the whole.'

"In another pamphlet, which had been previously published at Paris in 1785, the author not only

supposed that the machine was put in motion by a dwarf, a famous chess-player; but he goes so far as to explain the manner in which he could be accommodated within the machine. The invisibility of the dwarf when the doors were opened was explained by his legs and thighs being concealed in two hollow cylinders, while the rest of his body was out of the box, and hid by the petticoats of the automaton. When the doors were shut, the clicks produced by the swivel of a ratchet-wheel permitted the dwarf to change his place, and return to the box unobserved; and while the machine is wheeled about the room, the dwarf had an opportunity of shutting the trap through which he passed into the machine. The interior of the figure was next shown, and the spectators were satisfied that the box contained no living agent.

"Although these views were very plausible, yet they were never generally adopted; and when the automaton was exhibited in Great Britain in 1819 and 1820, by M. Maelzel, it excited as intense an interest as when it was first produced in Germany. There can be little doubt, however, that the secret has been discovered; and an anonymous writer has shown in a pamphlet, entitled '*An attempt to analyse the Automaton Chess Player of M. Kempelen*,' that it is capable of accommodating an ordinary-sized man; and he has explained in the clearest manner how the inclosed player takes all the different positions, and performs all the motions which are necessary to produce the effects actually observed. The following is the substance of his observations:—

"The drawer GG when closed does not extend to the back of the chest, but leaves a space behind it, fourteen inches broad, eight inches high, and three feet eleven inches long. This space is never exposed to the view of spectators. The small cupboard seen at A is divided into two parts, by a door or screen, which is moveable upon a hinge, and is so constructed that it closes at the same instant that B is closed. The whole of the front compartment is occupied with the machinery. The other compartment is empty, and communicates with the space behind the drawer, the floor of this division being removed. The back of the great cupboard CC is double, and one part of it moves on a joint at the upper part, and forms when raised an opening between the two cupboards, by carrying with it part of the partition, which consists of cloth tightly stretched.

"When the spectator is allowed to look into the trunk of the figure by lifting up the dress, a great part of the space is occupied by an inner trunk which passed off to the back in the form of an arch, and conceals from the spectators a portion of the interior. This inner trunk opens and communicates with the chest by an aperture about twelve inches broad and fifteen high. When the false back is raised, the two cupboards, the trunk, and the space behind the drawer, are all connected together.

"The construction of the interior being thus understood, the chess-player may be introduced into the chest through a sliding panel. He will then raise the false back of the large cupboard, and assume the position represented by the shaded figure in Figs. 3 and 4. Things being in this state, the exhibitor is ready to begin his process of deception. He first opens the door A of the small cupboard, and from the crowded and very ingenious disposition of the machinery within it, the eye is unable to penetrate far beyond the opening, and the spectator

concludes, without any hesitation, that the whole of the cupboard is filled, as it appears to be, with similar machinery. This conclusion is greatly corroborated by observing the glimmering light which plays among the wheel-work when the door B is opened, and a candle held at the opening. This mode of exhibiting the interior of the cupboard satisfies the spectator also, that no opaque body, capable of holding or concealing any of the parts of a hidden agent, is interposed between the light and the observer. The door B is now locked and the screen closed, and as this is done at the time that the light is withdrawn, it will wholly escape observation.

"The door B is so constructed as to close by its own weight, but as the head of the chess-player will soon be placed very near it, the secret would be disclosed if, in turning round, the chest door should by any accident fly open. This accident is prevented by turning the key, and, lest this little circumstance should excite notice, it would probably be regarded as accidental, as the keys were immediately wanted for the other locks.

"As soon as the door B is locked, and the screen closed, the secret is no longer exposed to hazard, and the exhibitor proceeds to lead the minds of the spectators still farther from the real state of things. The door A is left open to confirm the opinion that no person is concealed within, and that nothing can take place in the interior without being observed.

"The drawer GG is now opened, apparently for the purpose of looking at the chess-men, cushion and counters, which it contains; but the real object of it is to give time to the player to change his position, as shown in Fig. 5, and to replace the false back and partition preparatory to the opening of the great cupboard. The chess-player, as the figure shows, occupies with his body the back compartment of the small cupboard, while his legs and thighs are contained in the space behind the drawer GG, his body being concealed by the screen, and his limbs by the drawer GG.

The great cupboard CC is now opened, and there is so little machinery in it that the eye instantly discovers that no person is concealed in it. To make this more certain, however, a door is opened at the back, and a lighted candle held to it, to allow the spectators to explore every corner and recess.

"The front doors of the great and small cupboard being left open, the chest is wheeled round to show the trunk of the figure, and the bunch of keys is allowed to remain in the door D, as the apparent carelessness of such a proceeding will help to remove any suspicion which may have been excited by the locking of the door B.

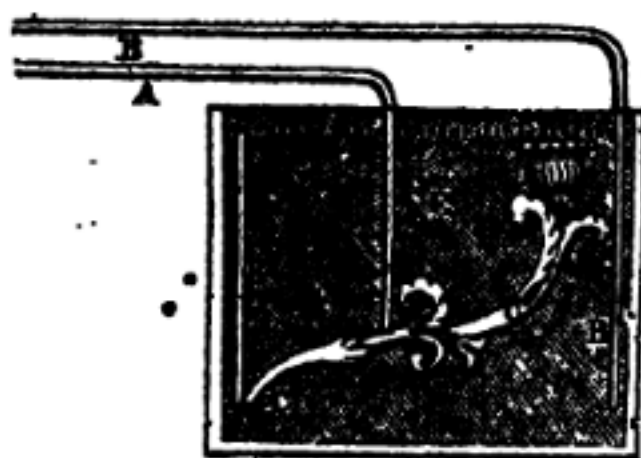
"When the drapery of the figure has been raised, and the doors E and F in the trunk and thigh opened, the chest is wheeled round again into its original position, and the doors E and F closed. In the meantime the player withdraws his legs from behind the drawer, as he cannot so easily do this when the drawer GG is pushed in.

"In all these operations, the spectator flatters himself that he has seen in succession every part of the chest, while in reality some parts have been wholly concealed from his view, and others but imperfectly shown, while at the present time nearly half of the chest is excluded from view.

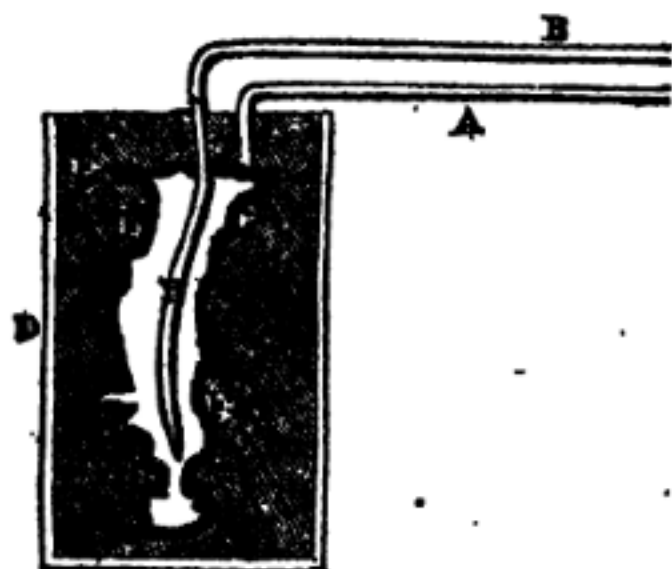
"When the drawer GG is pushed in, and the doors A and C closed, the exhibitor adjusts the machinery at the back, in order to give time to the

desired to be obtained is a vase, as represented in Fig. 1, where A, represents a wire from the positive plate, in connexion with the mould, C. B, the wire from the negative plate, in connexion with B, which is a plate of gold or silver to be dissolved. E, represents a solution of gold or silver, within and without the model or mould, C.

"In Fig. 2, C, represents a mould or model of a branch, upon the external surface of which the deposition of gold or silver is supposed to be proceeding. B, a plate of gold or silver surrounding the model or mould, C, and immersed in a solution of gold or silver, E.



"In Fig. 3, F, represents a copper deposited model or mould, within which the deposition of gold or silver is desired to be obtained. The other letters of reference are used to denote the same things as in Fig. 1. Having produced the article desired, in gold or in silver, if it be a bust, or figure, or ornament, and requires to be of greater strength than it is desired to obtain by a thickness of gold or silver, I strengthen the article by causing a deposit of copper or other metal, by electric means, within the article of silver or gold, or I fill the article of gold or silver with fusible metal or other material.



"Having thus described the nature of my invention, and the manner of performing the same, I would wish it to be understood, that what I claim as the invention, secured under the above-recited letters patent; is first, the mode of manufacturing articles of gold and silver by depositions thereof, by electric agency in or on suitable moulds or models, which may be removed from the articles of gold or silver when the same have been formed, as above described.

"Secondly, I claim the mode of manufacturing articles of gold or silver on or in metal moulds or models, which are deposited by electric means, such moulds or models being afterwards removed, as described.

"Thirdly, I claim the mode of manufacturing articles of gold or silver by electric deposition on or

in moulds or models, when such moulds or models are removed by heat or by solution.

"Fourthly, I claim the mode of manufacturing articles of gold or silver by electric deposition, in or on moulds or models made up of parts.

"Fifthly, I claim the mode of strengthening articles of gold and silver produced in or on moulds by electric depositions, by introducing a baser metal within them.—In witness whereof, &c.

"Enrolled, Sept. 29, 1841. "ALEXANDER FARRER."

PHENOMENA OF CAPILLARY TUBES.

CAPILLARY tubes are tubes of glass, the interior aperture of which is very narrow, being only half a line, or less, in diameter. The reason of this denomination may be readily perceived. These tubes are attended with some singular phenomena, in the explanation of which philosophers do not seem to have agreed. Hitherto it has been easier, in this respect, to destroy, than to build up. The principal of these phenomena are as follow:—

1. It is well known that water, or any other fluid, rises to the same height in two tubes, which have a communication with each other; but if one of the branches be capillary, this rule does not hold good: the water in the capillary tube rises above the level of that in the other branch; and the more so, the narrower the capillary tube is. It seemed very easy to the first philosophers, who beheld this phenomenon, to give an explanation of it. They supposed that the air, which presses on the water in the capillary tube, experiences some difficulty in exercising its action, on account of the narrowness of the tube; and that the result must be an elevation of the fluid on that side. This however was not very satisfactory; for what reason is there to think that the air, the particles of which are so minute, will not be at perfect freedom in a tube half a line, or a quarter of a line, in diameter? But whether this explanation be satisfactory or not, it is entirely overturned by the second and third phenomena of the capillary tubes.

2. When mercury is employed, instead of water, this fluid, instead of rising in the capillary branch, to the level which it reaches in the other, remains below that level.

3. If the experiment be performed in vacuo, every thing takes place the same as in the open air. The cause of this phenomenon then is not to be sought for in the air.

4. If the inside of the tube be rubbed with any greasy matter, such as tallow, the water, instead of rising above the level, remains below it. The case is the same, if the experiment be made with a tube of wax, or the quills of a bird, the inside of which is always greasy.

5. If the end of a capillary tube be immersed in water, this fluid immediately rises above the level of that in the vessel, and to the same height to which it would rise in a siphon, if one of its branches were a capillary tube, and the other of the common size; so that if the surface of the water only be touched, it is immediately attracted, as it were, to the height above mentioned, and it remains suspended at that height when the tube is removed from the water.

6. If a capillary tube be held in a perpendicular direction, or nearly so, and if a drop of water be made to run along its exterior surface, when the drop reaches its lower aperture, it enters the tube, if it be of sufficient size, and rises to the height at

which it would stand, above the level, in the branch of a siphon, of that calibre.

7. The heights at which water maintains itself in capillary tubes, are in the inverse ratio of the diameters. Thus, if water rises to the height of ten lines in a tube one-third of a line in diameter, it ought to rise to the height of 20 lines in a tube one-sixth of a line in diameter, and to the height of 100 in a tube one-thirtieth of a line in diameter.

The falling of mercury below the level in such tubes, follows also the inverse ratio of the diameters of the tubes.

8. Those persons would be deceived who should imagine, that the lightest liquors rise to the greatest height in these tubes: of aqueous liquors, spirit of wine is that which rises to the least height. In a tube in which water rises twenty-six lines, spirit of wine rises only nine or ten. The elevation of spirit of wine, in general, is only the half or a third of that of water.

This elevation depends also on the nature of the glass; in certain tubes, water rises higher than in others, though their calibres be the same.

To be convinced that these effects are not produced by anything without the tube or the liquor, it is necessary to see these phenomena, which are indeed the same in a vacuum, or in air highly rarefied, as in the air which we breathe. They vary also according to the nature of the glass of which the tube is formed; and they are different according to the nature of the fluid. The causes therefore must be sought for in something inherent in the nature of the tube, and in that of the fluid.

This cause is generally ascribed to the attraction mutually exercised between glass and water. This explanation has been controverted by Father Gerdil, a Barnabite and an able philosopher, who has done everything in his power to overturn it. On the other hand, M. de la Lande has stood forth in its defence, and is one of those modern writers who have placed this explanation in the clearest light.

MANUFACTURE OF CIGARS.

THE greatest manufacturers of Havannah cigars are Cabanas, Hernandez, Silva, and Rencardul; there are a hundred others of less note, who make from 10,000 to 100,000 a day. The cigar is composed of two distinct parts, the inside and cover. For these, two different kinds of leaves are used, of which the latter is generally finer in texture, as well as more pliant. These leaves are damped the night previous to their being made up; when rolled, they are placed on a large table, where they are divided into the various qualities of first, second, third, &c., and priced accordingly. Those which are most carefully rolled are called *Regalias*, and are sold at 22 dollars, 23 dollars, and 26 dollars a thousand; while the second-best, which are of the very same tobacco, and made by the same man, (only with less care,) are sold at 14 dollars, others as low as 6 dollars. D. Hernandez employs about fifty men in his manufactory. Of the best common cigars, a workman can make 1,000 in a day; of the *Regalias*, 600; so that the daily issues from an immense fabric are about 30,000 cigars, which, at 14 dollars per 1,000, would give nearly £100 a day. They pay an export duty of half a dollar per thousand, and an import duty in England of 9s. Allowing for freight and insurance, twenty per cent. profit to the importer, and twenty more to the retailer, the best Havannah cigars should be sold in London at 25

per 1,000, which is 18d. per 16, or about 1½d. each; instead of which they are generally charged 30s. to 40s., and sometimes 60s., and from 3d. to 4d. a piece. The very best in quality do not find their way to Europe, because they are not fashionable here: they are generally dark-colored; whereas, a light-colored and smoothly-rolled cigar is preferred to the strong and highly-flavored rough ones, which are the best. The finest tobacco in Havannah grows in the *Vuelta Abaga*, or lower district.

HOUSE PAINTING.

THE material chiefly employed in plain painting is white lead. It is a carbonate of lead produced by the action of the vapor of vinegar on sheet lead; and, when ground up with linseed oil, forms the common white lead paint of commerce. It is improved by being kept for several years. To produce the different tints, various colors are added to the white lead base, in quantity according to the intensity of the tint desired, amounting, sometimes, to an exclusion of the white lead in the upper or finishing coats. The following are the colors generally used by the house painter:—

<i>White.</i>	<i>Spanish brown.</i>
White lead.	York brown.
Nottingham white.	<i>Reds.</i>
Flake white.	Vermilion.
<i>Black.</i>	Scarlet lake.
Ivory black.	Crimson lake.
Lamp black.	Indian red.
Blue black.	Venetian red.
Patent black.	Red lead.
<i>Yellows.</i>	Orange lead.
Chrome yellow.	Burnt ochre.
King's yellow.	Burnt sienna.
Naples yellow.	<i>Greens.</i>
Yellow ochre.	Brunswick green.
Raw sienna.	Emerald green.
Yellow lake.	Verdigris.
<i>Browns.</i>	<i>Blues.</i>
Burnt umber.	Prussian blue.
Raw umber.	Indigo.
Vandyke brown.	Cobalt.
Purple brown.	Ultramarine.

To bring these colors to a state fit for use, they are ground up with a small quantity of oil; but for painting in distemper, the colors must be ground up in water. Linseed oil is that which is in general use, and is quite sufficient for the purpose of the plain painter, especially when improved by being kept for several years, as it then loses a great part of its color. It is obtained by pressure from the seed of flax. In very rare instances, where the least yellowness in the oil would be injurious, nut or poppy oil may be used with advantage.

Spirits of turpentine is largely employed in painting; it is obtained by distillation from crude turpentine, which is procured from the larch and fir-trees: being of a volatile nature, it is used by the painter to produce what is called a flat; it evaporates, and leaves the paint without the least shine. It is also employed in those situations where oil would not dry, as in the first coat on old work, which is likely to be a little greasy from smoke, &c.

To hasten the drying of paints, *dryers* are generally used. Those most in use are sugar of lead, litharge, and white copperas. These, when well ground, and mixed in small portions with paint, very much assist them in drying; indeed, some colors will not dry without them. Red lead is also an excellent dryer; and in cases where its color is not objectionable, is much used. Sugar of lead is, however, the best dryer, though somewhat more expensive than the others. It should be observed,

that, in the finishing coats of delicate colors, dryers are generally avoided, as they have a slight tendency to injure the color. Linseed oil has sometimes a drying quality given to it by boiling with drying substances, which renders it extremely useful on some occasions. A very good drying oil is made by boiling one gallon of linseed oil with a quarter of a pound of litharge, or red lead, reduced to a fine powder. It must be kept slightly boiling for about two hours, or until it ceases to throw up any scum; when cold, the clear oil must be poured off, and kept for use.

The tools and apparatus employed by the plain painter are not very numerous; we shall mention the principal of them. The first in order is the grindstone and muller. This is an apparatus necessary to every painter, as the purity of the colors sold ready ground at the shops is not to be depended upon; and some colors, as lakes and Prussian blue, will not keep long after grinding. The grindstone is a slab of porphyry marble, or granite, about two feet square; the chief requisite is, that it be hard, and close-grained.

The muller is a hard and conical-formed stone, the diameter of the base or rubbing surface of which should be about one-sixth of that of the grindstone, and the cone high enough to get a sufficient hold of it with the hands. The face of both grindstones and muller should be perfectly flat and smooth. A large palette knife is used to gather the color from the stone as soon as it is sufficiently ground.

The palette is a small thin board, of an oval shape, having a hole in it for the thumb to pass through; it is used chiefly in ornamental painting, and for mixing up small portions of color on. With this is employed the palette knife, for mixing up colors on the palette; it has a long, thin, and elastic blade, rounded at the extremity.

The most important of the painter's tools are the brushes: these are of all sizes, both round and flat, and are made chiefly of hog's-hair. The large round brush called the pound brush, and a smaller one called the tool, are those mostly used in plain work. The smallest hog's-hair brushes are called fitches, and are used for putting in small work where the tool would be too large. The pound brush is used as a duster for some time previous to putting it in color, whereby it is rendered much softer. The smallest brushes are the camel-hair pencils with long or short hair, according to the work to be done.

The stopping-knife has a shorter blade than the palette-knife, and is pointed. It is used for making good the holes and cracks with putty.

Putty is made of common whiting, pounded fine, and well kneaded with linseed oil, till it becomes about the consistence of stiff dough.

Grinding Colors.—All substances employed for painting in oil require to be ground up with a small portion of the oil, previous to mixing them with the whole quantity required for use; for this purpose, they must first be pounded, and passed through a tolerably fine sieve, then mixed with a portion of linseed oil, just sufficient to saturate them; a quantity, about the size of a small egg, is to be taken on the point of the palette-knife, and placed on the stone; the muller is then placed upon it, and moved round about, or to and fro in all directions, bearing a little weight on it at the same time. This should be continued until it is ground perfectly fine, having the consistence and smoothness of butter. The

color must be occasionally trimmed from the edges of the stone and muller with the palette-knife, and put under the muller in the middle of the stone. When sufficiently ground, it is removed from the stone with the palette-knife, and a fresh quantity taken. It is not well to have much color on the stone at one time; it makes it more laborious, and will take a longer time to grind the same quantity equally well.

Mixing Colors for Painting.—Before the colors which have been ground can be applied to the work, they must be rendered fluid by the addition of linseed oil, or spirit of turpentine, or certain proportions of both. When a tinted color is required to be mixed up, a small quantity of the proper tint should be first prepared on the palette, which will serve as a guide to mix the whole quantity by. With the ground white lead there should first be well mixed a portion of oil, and then the tinting color should be added, as ascertained by the pattern on the palette. When these are thoroughly mixed and matched to the proper tint, the remaining portion of the oil or turpentine is to be added; this is better than putting in all the oil at once: it should then be strained through a piece of fine canvass, or fine sieve, and should be about the consistence of cream, or just so as to work easily. If it is too thick, the work will have an uneven, cloudy appearance, and it will be hard to spread; while, if it be too thin, it will be likely to run, or will require a greater number of coats to cover the ground, and render the work solid. The straining ought not to be neglected where the appearance of the work is studied.

(To be continued.)

MEMORANDA.

Thin polished plates of white marble are now strongly recommended by several French artists, as a substitute for ivory in miniature painting.

The slices of marble are cemented down upon a sheet of paste-board, to prevent danger of fracture; they are said to take the color with great freedom, and to hold it with tenacity; and it is obvious, that they are incapable of any change by time, or the effects of heat or damp. Ivory, it is well known, becomes yellow; and in hot climates often splits or warps. It can only be obtained also of a very limited size; whereas, these plates of the finest grained statuary marble can be obtained of any size.

Plates of about 12 inches by 10 inches are prepared of only about three-sixteenths of an inch thick, and smaller ones thinner in proportion. Marble has been occasionally used before now as a plane for painting on in oils; but its application to miniature painting is certainly new, and seems valuable.

Death of the Electrical Eel.—This eel, (mentioned in Vol. I. p. 254,) died of mortification a short time since at the Adelaide Gallery. The seat of the electric power lay between the shoulder and the tail, and it could exert it for two feet or more distant—a remarkable circumstance, as it implies a power in the fish of driving the electric current in any direction, away from itself, and of making it take a longer or shorter course according to the will of the animal. It was ailing for some months before its death, refusing its food, which was small fishes, and losing its sight and power of motion. At the time of its death it was not more than five or six years old, and was brought from Guiana, where these dreadful fish abound.

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NEW EDITION

[11d.

Fig 1

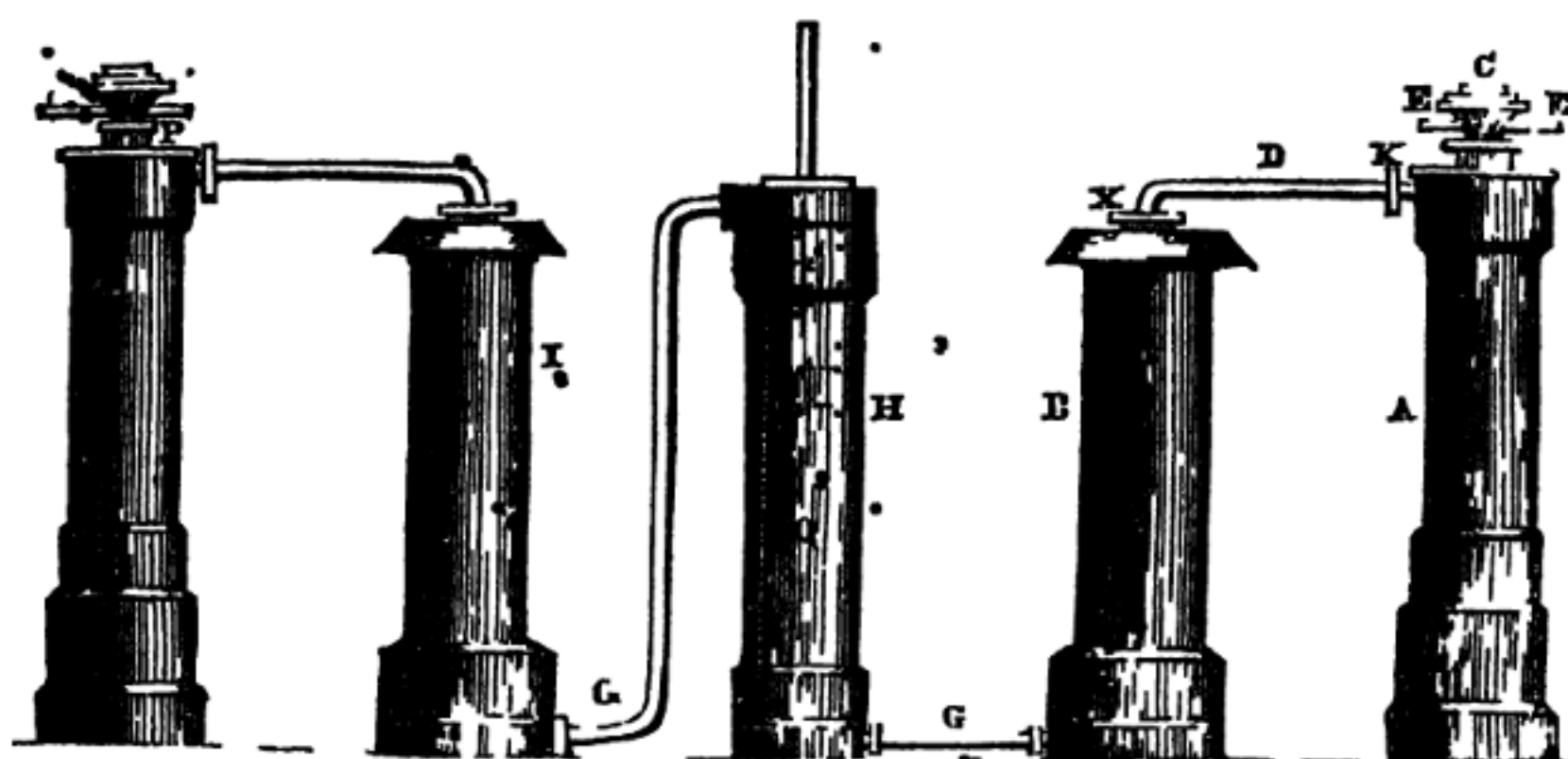


Fig 3

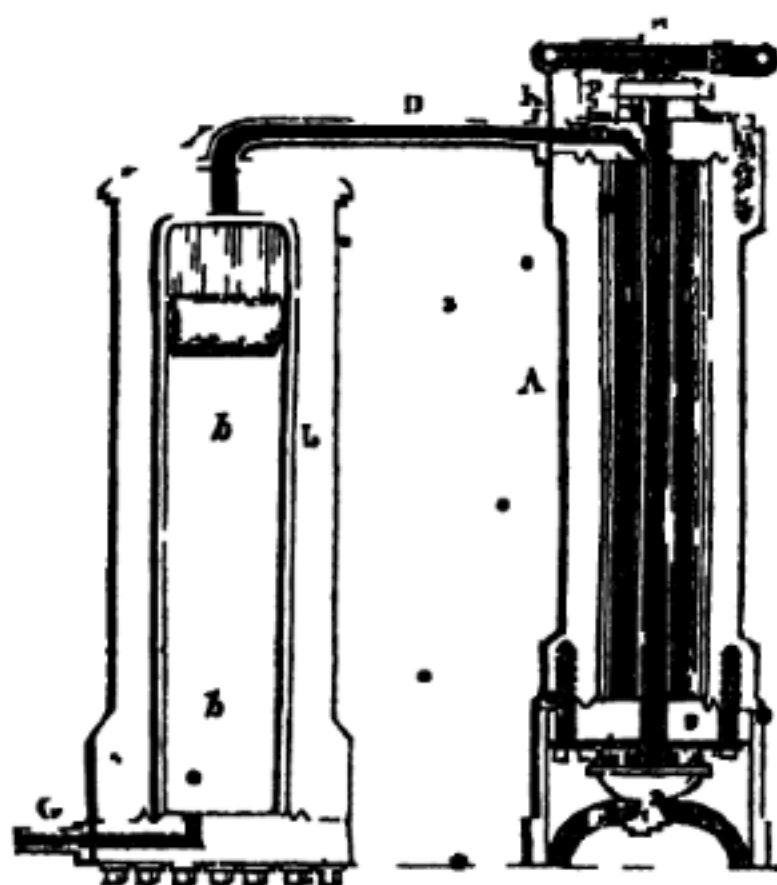
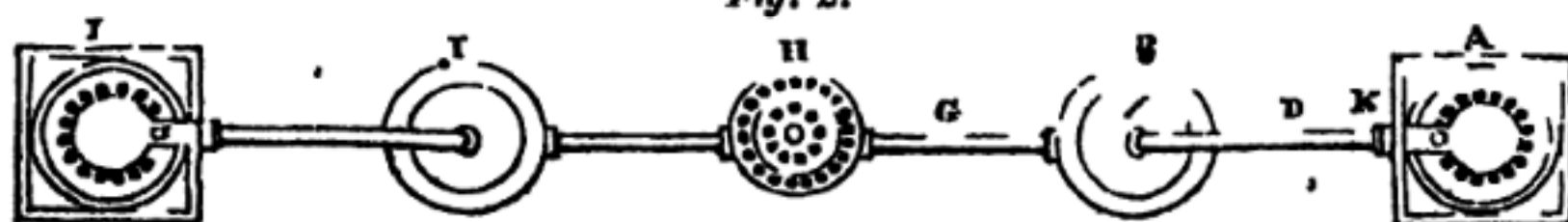


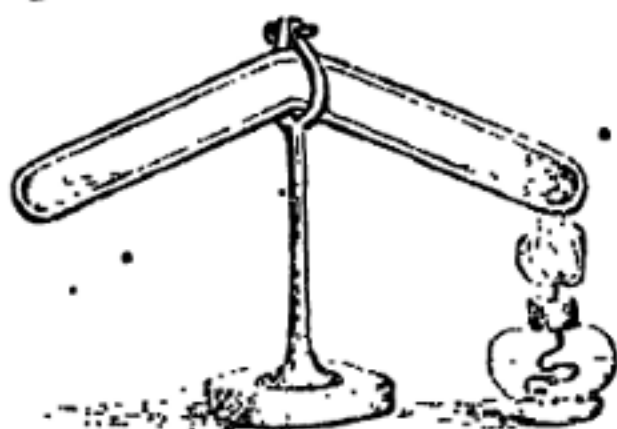
Fig. 2.



BRUNEL'S PATENT GAS ENGINE.

BRUNEL'S PATENT GAS ENGINE.

THIS invention is for the production of a power from the now well-known property of certain gases, to become liquefied when submitted to great pressure, and of recovering their gaseous form rapidly upon that pressure being removed. This instantaneous recovery of volume gives rise to a power proportionate to the quantity of gas employed. This may be illustrated in numerous ways, but none more familiar than in cutting the wire of a bottle of soda water, when the pressure of the condensed gas within, will, as is well-known, drive out the cork to a considerable distance. The liquefying of the gas may be shown as follows:—Procure a *thick* glass tube, half an inch in internal diameter, of the following form:—Fill one end of it with a paste made of the black oxide of manganese, common salt and sulphuric acid. When the ingredients are put in, hermetically seal the other end of the tube by a blow-pipe. Now apply heat to the ingredients, and chlorine gas will be formed; this will condense into a liquid in the other end of the tube, which should be kept as cold as possible. This experiment is not unattended with danger, owing to the liability of fracture of the glass tube, but it will show the principle of the liquefaction of a gas. If the tube be suffered to fall from a height, it will burst with a loud explosion, owing to the instantaneous expansion of the gas.



That which is true of chlorine, is equally so with some other gases. Sulphuretted hydrogen and more especially, carbonic acid, which gas at the temperature of freezing water, requires a pressure of about thirty atmospheres to condense and retain it in a liquid state, for which, as a moving power, Mr. Brunel's apparatus has been adapted. The arrangement of the machinery is as follows, taken from Mr. Brunel's specification.

"The mechanical arrangements consist chiefly of two cylindrical vessels, denominated receivers, into which the liquid has been previously forced by a strong condensing pump, continuing the operation by pumping in gas, until it assumes the liquid state. One receiver is shown at A, Figs. 1 and 2; the other at J. The Fig. 3 is an enlarged section. The same letters designate the same things in the different figures. The communication from the pump to the receiver is through the orifice O, Fig. 3, which can be stopped at pleasure by a plug or stopcock P. When the receiver has been charged with the liquid and closed, a pipe D is attached to it at K, and connected at X with a vessel, denominated the expansion vessel B. This expansion vessel is connected through a pipe G, to a working cylinder represented at H. The Fig. 1 represents two receivers A and J, connected with the working cylinder H, through the intermediate expansion vessels B and I. These vessels contain oil, or any other suitable liquid shown at *l l*; Fig. 3, as a medium

between the gas and piston Q. Before explaining the action of these parts, I shall explain how the power is obtained in the receiver. The receiver consists, as represented in Fig. 3, of a strong metal cylinder, in the interior of which there are one or more thin metal vessels; tubes are most convenient as represented at T T T. The joints of these tubes through the bottom and top of the receiver are made perfectly tight. The use of these tubes is to apply alternately heat and cold to the liquid contained in the receiver, without altering very sensibly the temperature of the cylinder. The operation of heating and cooling through the thin tubes, may be effected with warm water, steam, or any other heating medium, and cold water, or any other cooling medium. For this purpose, the tubes are connected at the top and bottom by a chamber and cock C. By the opening of these cocks with the pipes E E, hot and cold water may be alternately let in, and forced through by means of pumps. Now if the hot water, say at 120° , is let in through the tubes of the receiver A, Fig. 1, and cold water at the same time through the tubes of the receiver J, the liquid in the first receiver will operate with a force of about ninety atmospheres, while the liquid in the receiver J will only exert a force of from forty to fifty atmospheres. The difference between these powers will therefore be the moving power, which, through the medium of the oil, will operate upon the piston Q in the cylinder H. It is easy to comprehend that letting hot water through J, and cold water through A, a re-action will take place, which will produce in the working cylinder H, an alternate movement of the piston Q, applicable by means of the piston rod to various mechanical purposes as required."

TERRESTRIAL AND CELESTIAL GLOBES.

THE general appearance of a globe, whether celestial or terrestrial, is familiar to most persons; while the rules by which certain astronomical and geographical problems are solved with its aid, are laid down in that course of school study which is termed the "use of the globes." There are, however, many readers who cannot tell *why* the use of the globes enables us to arrive at approximately correct results, nor what relation the lines and circles on the globes bear to any particular phenomena on the earth's surface or in the heavens. To such readers the present paper is addressed.

Globes are distinguished as "celestial" and "terrestrial;" the former for performing certain problems relating to the heavenly bodies, and the latter for other problems relating more particularly to the earth's surface. It will, however, be convenient to speak separately of the globe itself, of the delineations on its surface, and of certain appendages belonging to it. The globe, whether it be for astronomical or geographical purposes, is made in the same way. It is a hollow sphere of pasteboard, made generally by pressing several thicknesses of paper together and moulding them to a hemispherical form on a wooden mould, which is afterwards removed. The two hemispherical shells are then fastened to each other and to the two ends of a common axis; and the sphere thus formed is brought to a proper level by a composition laid on the surface, smoothed, and made ready to receive the delineations on the surface. These delineations, of which we shall speak presently, are engraved on a copper-plate, and printed on narrow gores or gas-

sets of paper, which are pointed at each end, and are so shaped that the whole of them will exactly cover the surface of the globe. The gores are pasted on, and the globe is finally colored and varnished.

The delineations on the terrestrial globe are founded on the supposition that the globe represents the earth's surface, an assumption which, though not quite correct (on account of the earth being a spheroid instead of a sphere), is near enough for the purposes to which the globe is applied. But in the case of the celestial globe, the assumption is of a very different kind. We cannot assign either form or dimensions to the heavens; they are, and ever must be to the human mind, illimitable and immeasurable. Considered, however, merely as they appear to us, the stars, planets, &c., may be deemed to occupy a vast concave vault or sphere, extending around us in every direction; and this mode of viewing the subject is taken advantage of in the delineations on a celestial globe. If we were placed in the centre of a glass sphere, through which we could see all the heavenly bodies, and were to make marks on the glass at all the spots where those bodies appeared, the marks would become in some measure a record of the relative distances at which the stars seem apart. This is the principle of the celestial globe, which is an artificial representation of the heavens, and in using which the student is supposed to be situated in the centre, and to view the stars in the concave surface.

This, then, being the main difference in the construction of the two globes, we may proceed to state that the delineation of towns, countries, seas, rivers, &c., on the one, and heavenly bodies on the other, is not enough; there must be certain lines and circles drawn on the surface to adapt it to the wants of the student. These lines and circles are, generally speaking, means of reference, by which positions are ascertained; there are some which are common to both globes, while there are others which belong to one globe only. The principal of these points and circles we may here enumerate.

As all the phenomena of day and night result from the diurnal rotation of the earth on its axis, the extremities of this axis, called the *poles*, become as it were fixed points, and two points on the terrestrial globes are marked to represent these two poles. As these poles point, with very slight deviation, each towards one particular point in the heavens, we obtain two points called the poles of the heavens, in the prolongation of the earth's axis; these two points are marked in the celestial globe. The *equator*, or the equinoctial line, is the name which we apply to the circle encompassing the earth midway between the two poles, dividing the earth into two halves: this circle is marked on the terrestrial globe; and as we may conceive a similar circle to encircle the vault of the heavens midway between its poles, such a one is likewise drawn on the celestial globe. The *ecliptic* is that path among the stars which the sun seems to traverse as seen from the earth, or which the earth would seem to traverse if viewed from the sun, in the course of a year; such a circular path is marked on the celestial globe, in its proper direction with respect to the stars; and a similar circle is marked on the terrestrial globe, bearing the same relation to the terrestrial equator which the celestial ecliptic does to the celestial equator. The sun is never vertical at any point of the earth's surface further north or south of the equator than about $23\frac{1}{2}^{\circ}$; the circles drawn round the earth at these two points parallel

with the equator, are the two *tropics*, which are marked on the terrestrial globe; and two similar circles are marked on the celestial globe, bearing the same relation to its equator which the others do to the terrestrial equator. Lastly, there are two regions surrounding the poles of the earth, in each of which, at certain times of the year, the sun is above the horizon even at midnight, and below the horizon even at mid-day in another season of the year; the boundaries which separate these two regions from all the other parts of the earth in which the sun rises and sets every day, are the *polar circles*, and are marked both on the terrestrial and celestial globes. If we suppose the poles, the equator, the ecliptic, the tropics, and the polar circles, to be marked on a transparent globe, in the centre of which the eye is placed, these lines would appear projected on the vault of the heavens, in their proper relative positions; and the celestial globe is marked in conformity with this projection.

There are other circles and symbols on the surfaces of globes which differ according as the globe is terrestrial or celestial. In astronomical calculations it is customary to lay down the position of a star by referring it to the ecliptic; while the positions of the sun and moon are also frequently considered with reference to the same standard. Hence there are two important points in the heavens called the poles of the ecliptic, at equal distances from the plane of the ecliptic; these are represented on most celestial globes and maps of the stars, whereas in terrestrial globes and maps they are not wanted. In nice astronomical computations it is necessary to bear in mind that the pole of the equator revolves slowly round the pole of the ecliptic; but the motion in a year, or even in a century, is so minute, that in all ordinary circumstances we may consider both poles as fixed points, and consequently fixed points on the celestial globes. (On terrestrial globes there are several circles drawn equidistant from one another, all at right angles with the plane of the equator, and passing through the two poles; these are *meridians*, intended to facilitate the determination of the longitude of any spot. If such meridians are delineated on a celestial globe (and the size of the globe often determines the kind and number of the circles delineated), they are called *declination circles*, because the position of a star with respect to the celestial equator, measured along the circles just spoken of, is called the *declination*, not the *latitude*; the latter being measured from the ecliptic, and not from the equator. This difference between the latitude of a star and of a geographical position is sometimes embarrassing to a student. Again, the longitude of a geographical position is reckoned on the equator, whereas that of a heavenly body is reckoned on the ecliptic; the measurement on the celestial equator, being termed the *right ascension* of a heavenly body.

But the chief difference in the delineations on the two kinds of globes is the representation of countries, towns, &c. on the one, and of stars on the other. The latitude and longitude of almost every important place on the earth's surface have been ascertained, within a certain limit of error; and the map-draughtsman, who prepares the delineations, lays down the positions in conformity with these two elements. The various parts of the earth's surface are delineated on one or other of the gores or gussets to which we before alluded, then engraved on a copper-plate, and finally adjusted to the globe. A similar mode is adopted in the delineations on the

celestial globe, though the delineations themselves are different. All the stars in the visible heavens, down to a certain magnitude, have been catalogued; that is, they have had names or symbols attached to them (such as the letters of the Greek alphabet, the numerals, &c.), and have had their latitudes and longitudes calculated. The ecliptic is supposed to be divided into 360° ; a certain point in it (called the first point of Aries) is selected as a starting point, and the longitude of the star, measured on the ecliptic, is its distance in degrees eastward of this point. Then, again, the distance of a star from the ecliptic, measured in degrees in a direction at right angles thereto, is its latitude; and if both the latitude and longitude of a body or a place be known, its exact position on the surface of the globe is indicated. In some catalogues of stars, the declination and right ascension, as well as the latitude and longitude, are given; the former pair giving the position of a star with respect to the equator, and the latter with respect to the ecliptic. From either pair, however, the exact position of a star may be ascertained; and the map-draughtsman proceeds to lay down all the stars which it may be proposed to include on the surface of the globe. With regard to the figures of bears, dogs, serpents, eagles, &c., on the surface of a celestial globe, we may merely state that this is a barbarism, arising out of the method by which the early astronomers grouped the stars for facility of reference, and continued by other astronomers from the difficulty of abrogating customs long acted on. Astronomers are, however, now engaged in the inquiry how these figures and the classification to which they have given rise may best be dispensed with; and the time is probably not far distant when our celestial globes will cease to be disfigured with these very unphilosophical delineations.

(To be continued.)

STANHOPE LENS.

M. CH. CHEVALIER details the following as some of the inconveniences of the Stanhope lens:—

1. The focus, not being capable of adjustment, two individuals of different sight cannot make use of the same instrument:

2. As the object to be examined is fixed to the lens, it is requisite, on its removal, to rub the lens, in order to remove any adherent matter; and which, on account of the repeated friction, will soon be found scratched and unfit for use:

3. The magnifying power of this lens is too small to allow of its employment in a great number of instances, in which it would be exceedingly useful, on account of its great portability.

These disadvantages M. Chevalier has remedied, by employing a doublet, furnished with a very thin piece of glass, which is fixed in front of the lenses in a ring, (*barillet*), and put in motion by a very simple piece of mechanism. The instrument, supplied with this arrangement, may be adjusted to the focus of the operators, and is not so likely to be affected by the causes above mentioned.

M. Lerebours has made some remarks on M. Chevalier's objections to the use of the Stanhope lens, as above quoted. The first inconvenience exists, as M. L. asserts, in theory, *but only in the most near-sighted individuals*; and, in support of this opinion, he states that he has never met with a person who saw indistinctly with Stanhope lenses. To the second objection, M. L. cannot see how the

surface of the Stanhope lens becomes more scratched than the lamina of very thin glass used by M. Chevalier. *Thirdly*, The Stanhope lenses usually magnify 10 times; he has, however, made them with a magnifying power of 80 diameters. According to the experience of micographers, excessive enlargement is rather an inconvenience than an advantage; above all, in instruments intended for excursions. He further adds, that M. Chevalier, in detailing what appear to him as imperfections in the Stanhope lens, has omitted to speak of its advantages. Thus, he says nothing as regards the extent of field afforded by this lens, which amounts to 35° ; while Wollaston's Doublet, which he uses, scarcely has a field of 15° , and costs four times the money.

HOUSE PAINTING.

(Resumed from page 32, and concluded.)

Preparing work for, and manner of proceeding with, the painting. New work.—Clean the work, carefully removing all projections, such as glue, or whitening spots; this is easily done with the stopping knife and duster; then cover over the knots with a composition of red lead, called *knotting*. The red lead has the property of drying very hard; and if it were not used, the paint would not dry on the knots, and they would show through every coat. If the knots are very bad, they must be cut out. After knotting comes the priming, or first coat of paint. When the priming is quite dry, all nail-holes, cracks, and defects, are to be made good with putty; then proceed to the next coat, called the second color; when this is dry, those places are to be stopped which were omitted in the last coat; and proceed according to the number of coats intended to be given. It should be observed that second color for new work is made up chiefly with oil, as it best stops the suction of the wood; but second color for old work is made up chiefly with turpentine, because oil color would not dry or adhere to it so well. The color should be spread on as evenly as possible; and to effect this, as soon as the whole, or a convenient quantity, is covered, the brush should be passed over it in a direction contrary to that in which it is finally to be laid off; this is called *crossing*. After crossing, it should be laid off softly and carefully, in a direction contrary to the crossing, but with the grain of the wood, taking care that none of the crossed brush marks be left visible. The criterion of good workmanship is, that the paint be laid evenly, and the brush marks be not observed. In laying off, the brush should be laid into that portion of the work already done, that the joining may not be perceived. Every coat should be perfectly dry, and all dust carefully removed, before the succeeding one is laid over it.

Old work.—Carefully remove all dirt and extraneous matter with the stopping knife and duster; those places near the eye should be rubbed with pumice-stone, and greasy places should be well rubbed with turpentine. Bring forward new patches and decayed parts with a coat of priming; stop and make good with putty. Then proceed with the first coat, or second color, in turpentine. The quality of the next coat will depend upon the manner in which it is to be finished. If it is to be painted twice in oil, and flatted, the next coat, or third color, should be mixed up chiefly in oil, and tinted like the finishing color, to form a ground for the flating. The greater the shine of the ground, the more dead will be the finishing coat or flating be: likewise, the more dead the ground, the better will the finishing oil

shine; therefore, it is a general rule that for finishing in oil the under coat should be turpentine, and for finishing flat, the under coat, or ground color, should be oil; but observe, that all turpentine under coats have a little oil with them, and all oil under coats, except the priming or first coat on new work, have a little turpentine with them.

Knotting is made with red lead, carefully ground, and thinned with boiled oil and a little turpentine. For inside work, red lead, carefully ground in water, and mixed up with double size, is a good substitute, and is generally used: it must be used hot.

Priming for new work.—This is made of white lead with dryers, and a little red lead to harden it, and further to assist its drying; it is thinned entirely with oil, and should be made very thin, as the new wood, or plaster, sucks it up very fast. It is a frequent practice with painters to save the oil coats by giving the new work a coat of size, or size and water, with a little whitening, called clearcole; but where durability is consulted, this should not be done. The size stops the suction of the wood or plaster, but, at the same time, it prevents the oil paint from adhering to the work; the consequence is, that it is apt to peel or chip off, especially in damp places. Clearcole is sometimes advantageously used on old greasy work, on which oil paint would not dry.

Second color for new work, or oil second color.—This is white lead thinned with oil and a little turpentine, with suitable dryers. The proportion of dryers for ordinary cases is about one ounce and a half to ten pounds of white lead; but in winter, or under other unfavorable circumstances, the quantity of dryers must be increased.

Second color for old work, or turpentine second color.—This is white lead thinned with about three parts of turpentine, and one of oil, also a little dryers. Where much turpentine is used, less dryers are required.

Turpentine color.—This is only used when the work is to be finished in oil; that is left shining. It is thinned almost entirely with turpentine, that the finishing coat may have a better gloss.

Third, or ground color, is thinned with two-thirds oil and one-third turpentine, and tinted a shade darker than the finishing color.

Finishing oil color is thinned with a little more oil than turpentine, and tinted to the desired color.

Flatting, or finishing turpentine color, is thinned entirely with turpentine, and has no shine.

A bastard flat is thinned with turpentine and a little oil, which renders it more durable than the perfect flatting. To procure a good flat, it is necessary to have a perfectly even glossy ground, and it should be of the same tint, but a little darker than the finishing flat.

For clearcole and finish.—Stop defects with putty, clearcole, and finish with oil-finishing color, as directed.

For two coats in oil.—Turpentine second color, and finishing oil color.

For two coats in oil and flat.—Turpentine second color; third color, and flat.

For three coats in oil.—Turpentine second color; turpentine color; and finishing oil color.

For three coats in oil and flat (old work).—Turpentine second color; turpentine color; third, or ground color; and flatting.

For four coats in oil (new work).—Oil priming; oil second color; turpentine color; and oil finishing color.

For four coats in oil and flat (new work).—Oil priming; oil second color; turpentine color; third or ground color; and flatting.

TINTED COLORS.

Stone color.—White lead, with a little burnt or raw umber, and yellow ochre.

Gray stone color.—White lead, and a little black.

Drab.—White lead, with burnt umber and a little yellow ochre for a warm tint, and with raw umber, and a little black for a green tint.

Pearl color, or pearl grey.—White lead with black, and a little Prussian blue.

Sky blue.—White lead, with Prussian blue.

French grey.—White lead, with Prussian blue, and a little lake. These last, used in various proportions, will make purples and lilacs of all shades.

Mauve color.—White lead, with stone ochre, and a little vermilion or burnt stone ochre.

Buff.—White lead and yellow ochre.

Cream color.—Same as the last, with more white.

Lemon color.—White lead, with chrome yellow.

Orange color.—Orange lead, or chrome yellow and vermilion.

Peach color.—White lead, with either vermilion, Indian red, purple brown, or burnt stone ochre.

Gold color.—Chrome yellow, with a little vermilion and white.

Violet color.—White lead, with vermilion, blue and black.

Sage green.—Prussian blue, raw umber, and yellow stone ochre, with a little white, and thinned with boiled oil and a little turpentine.

Olive green.—Raw umber, with Prussian blue, thinned as before.

Pea green.—White lead, with Brunswick green, or with Prussian blue and chrome yellow.

Chocolate color.—Spanish brown, or Venetian red and black, thinned with boiled oil and a little turpentine.

Lead color.—White lead and black.

Plain opaque oak color.—White lead, with yellow ochre and burnt umber.

Plain opaque mahogany color.—Purple brown, or Venetian red, with a little black.

***Black** should be ground in boiled oil, and thinned with boiled oil and a little turpentine.

It will be obvious that the proportions of the colors above mentioned must be determined by the particular tone of color required.

VEGETABLE PERSPIRATION.

WHEN points of hairs are put into spring-water, as in the experiments of Sir B. Thompson, "Philos. Trans. LXXVII," and exposed to the light of the sun, much air, which loosely adhered to the water, rises in bubbles. A still greater quantity of air, and of a purer kind, is emitted by Dr. Priestley's green matter, and by vegetable leaves growing in water in sun-shine, according to Mr. Ingenhous's experiments; both which is suspected to be owing to a decomposition of the water perspired by the plant, for the edge of a capillary tube of great tenuity may be considered as a circle of points, and as the oxygen, or principle of vital air, may be expanded into a gas by the sun's light, the hydrogen or inflammable air may be detained in the pores of the vegetable.

Hence plants growing in the shade are white, and become green by being exposed to the sun's light; for their natural color being blue, the addition of

hydrogen adds yellow to this blue, and *tans* them green. It is supposed a similar circumstance takes place in animal bodies; their perspirable matter as it escapes in the sun-shine becomes decomposed by the edges of their pores as in vegetables, though in less quantity, as their perspiration is less, and the greatest part of it, which exhales from the lungs, not being exposed to the sun-shine, and thus by the hydrogen being retained, the skin becomes *tanned* yellow. In proof of this it must be observed, that both vegetable and animal substances become bleached white by the sun-beams when they are dead, as cabbage-stalks, bones, ivory, tallow, bees-wax, linen and cotton cloth; and hence it is supposed the copper-colored natives of sunny countries might become etiolated or blanched by being kept from their infancy in the dark, or removed for a few generations to more northerly climates.

It is probable that on a sunny morning much pure air becomes separated from the dew by means of the points of vegetables on which it adheres, and much inflammable air imbibed by the vegetable, or combined with it; and by the sun's light thus decomposing water the effects of it in bleaching linen seems to depend: the water is decomposed by the light at the ends or points of the cotton or thread, and the vital air unites with the phlogistic or coloring matters of the cloth, and produces a new acid, which is either itself colorless or washes out, at the same time the inflammable part of the water escapes. Hence there seems a reason why cotton bleaches so much sooner than linen, *viz.* because its fibres are three or four times shorter, and therefore protrude so many more points, which seem to facilitate the liberation of the vital air from the inflammable part of the water.

Bees' wax becomes bleached by exposure to the sun and dews in a similar manner as metals become calcined or rusty, *viz.* by the water on their surface being decomposed; and hence the inflammable material which caused the color becomes united with vital air, forming a new acid, and is washed away.

Oil close stopped in a phial not full, and exposed long to the sun's light, becomes bleached, as is supposed, by the decomposition of the water it contains; the inflammable air rising above the surface, and the vital air uniting with the coloring matter of the oil. For it is remarkable, that by shutting up a phial of bleached oil in a dark drawer, it in a little time becomes colored again.

The following experiment shows the power of light in separating vital air from another basis, *viz.* from azote. M. Scheele inverted a glass vessel filled with colorless nitrous acid into another glass containing the same acid, and on exposing them to the sun's light, the inverted glass became partly filled with pure air, and the acid at the same time became colored. But if the vessel of colorless nitrous acid be quite full and stopped, so that no space is left for the air produced to expand itself into, no change of color takes place.

A sun-flower three-feet and a half high, according to the experiment of Dr. Hales, perspired two pints in one day (Vegetable Statics,) which is many times as much in proportion to its surface, as is perspired from the surface and lungs of animal bodies; it follows that the vital air liberated from the surfaces of plants by the sun-shine must much exceed the quantity of it absorbed by their respiration, and that hence they improve the air in which they live during the light part of the day, and thus blanched vegetables will sooner become *tanned* into

green by the sun's light, than etiolated animal bodies will become *tanned* yellow by the same means.

It is hence evident, that the curious discovery of Dr. Priestley, that his green vegetable matter and other aquatic plants gave out vital air when the sun shone upon them; and the leaves of other plants did the same when immersed in water, as observed by Mr. Ingenhouz, refer to the perspiration of vegetables not to their respiration. Because Dr. Priestley observed the pure air to come from both sides of the leaves, and even from the stalks of a water-flag, whereas one side of the leaf only serves the office of lungs, and certainly not the stalks. And thus in respect to the circumstance in which plants and animals seemed the farthest removed from each other in their supposed mode of respiration, by which one was believed to purify the air which the other had injured, they seem to differ only in degree, and the analogy between them remains unbroken.

Plants are said by many writers to grow much faster in the night than in the day; as is particularly observable in seedlings at their rising out of the ground. This probably is a consequence of their sleep rather than of the absence of light; and in this they also resemble animal bodies.

HINDU PROCESSES OF QUARRYING AND POLISHING GRANITE.

(From the Transactions of the Asiatic Society.)

THE most usual mode followed in India is to employ the agency of fire. In this process, the granite rock is covered with dry bushes of the various acacias common on the plains, which are then fired, and kept burning until quite consumed. The intense heat causes a separation or exfoliation of the granite, to the depth, perhaps, of twenty-four inches, in the centre of the fire, but gradually thinning off towards the edges. The piece thus exfoliated is then detached, by driving in small iron wedges at the extremities, and is finally raised by a powerful lever. Sometimes the rock proves more refractory than usual, and then it is customary to pour cold water upon it when hot, or to drop on the surface a heavy boulder of greenstone or granite. When blocks are required for statuary or mill stones, or for any other purpose where greater thickness than one or two feet is requisite, another process is followed, precisely similar to that employed by the ancient Egyptians in quarrying the Syene. A great number of holes, an inch square, and of different depths, according to the size of the block wanted, are bored in the rock, close to each other, forming a connected chain around the piece to be detached. Each hole is then fitted with an iron wedge, and the whole are simultaneously and unremittingly struck with iron hammers, until their united force overcomes the adhesion of the block. The chisels used in piercing the holes are kept cool, by pouring water upon them while working, as is done in Europe. When long and thinner slabs are required for bridges, pavements, lintels, &c., a third process is employed, combining the principles of the two former. The rock is heated, as in the first mode, and the separation is completed by driving wedges into a chain of holes, as in the second. In this way Lieut. Newbold has seen blocks of eighty feet in length separated. He also observed that the Hindus take advantage of the calorific action of the sun's rays, in promoting the separation of the granite slabs; and that they, therefore, select the hot season for their work. He found the temperature of a rock at Dewaneonda to

be $120\frac{1}{2}^{\circ}$, while that of the surrounding air was only 100° in the sun, and $95\frac{1}{2}^{\circ}$ in the shade. Sometimes they pour cold water into the clefts made by the wedges, which greatly hastens the separation of the block. The polish given to Indian granites is at least equal to what is found in Egypt; and good specimens may be seen in the Mausolea of Golconda, at Bejanuggur, Galberga, and many other places in the peninsula. To effect this beautiful polish, two processes are followed. When a flat surface is required, the granite is slightly smoothed and flattened by an iron tool; and is then rubbed with a large and heavy block of granite, hollowed on its under surface, and having the hollow filled up by a mixture of lac and corundum. The mixture adheres strongly to the stone, which is tightly fixed between two rods. The extremities of these rods form the handles for two workmen, who draw the stone backwards and forwards over the block to be polished, occasionally throwing water on the surface, to prevent the lac from melting. When the piece to be polished is of a more varied form, as a cornice or moulding, or figure, a piece of wood, with the corundum mixture, or even a lump of the mixture alone, is used instead of the granite polisher. Any one who has seen the process will be strongly reminded of it by the paintings at Thebes, representing sculptors polishing a statue, which are copied by Rosellini, and in Wilkinson's "Ancient Egyptians." Lieut. Newbold mentions a remarkable fact connected with the granite of India: that much of it was in the form of spheroids and bosses, having a concentric laminar structure, like the coats of an onion, which frequently exfoliated by the action of the air, throwing off curved laminæ of very varied magnitude. This exfoliation of mountain masses produces some of the most picturesque features of the Indian landscape. It is the cause of its singular dome-shaped mountains and mamillary masses, crowned with tors which would in England be considered Druidical.

LORD ROSSE'S SPECULUM.

As an important incident in astronomical science, the casting of the gigantic speculum, which has been undertaken by Lord Rosse, is well worthy of attention. A letter from Dublin of the 16th instant, written by a gentleman who was present on the occasion, says "Nothing could be more successful than Lord Rosse's operation, nor more beautiful than all his arrangements. The casting was made at nine at night of yesterday, (Tuesday) and by ten we witnessed the building up of the monster speculum, of six feet diameter, and weighing three tons, in a hot oven built expressly to contain it, and where it will remain for the next two months, which time will be necessary for that gradual cooling process to which it must be subjected. Lord Rosse's present experiment, should it finally prove quite successful, is of the greater value since the mere expense is quite beyond the reach of the ordinary professional man. This last operation, after having satisfied himself of the manner and practicability of each part of the proceeding, could not have cost him less than £1000. If the final result proves satisfactory, which there seems no reason to doubt, he will have reached in the opinion of scientific men, the *maximum* of effect which is attainable, since the eye as they affirm, could not make use of a larger speculum, than about six feet diameter."—*Times*.

SPINNING CRYSTAL, MAKING RUBIES, &c.

M. GAUDIN has been employed for the last two or three years in the examination of the more refractory silicious substances, when in a fused state, and after they have been subjected to the intense heat of the oxy-hydrogen blow-pipe. The result of his numerous and interesting experiments are as under:—

M. Gaudin has succeeded in drawing out crystal into threads, several feet in length, with the greatest ease. One of these can be wound into a skein, and another wound round the finger. M. Gaudin has also found that melted rock crystal moulds easily by pressure, and that it is very volatile at a temperature little above its melting point. Alumina acts very differently from silica; is always perfectly fluid, or crystallized, and cannot be brought to a state of viscosity; while viscosity, separated from all tendency to crystallization, is the permanent condition of silica under the oxygen blowpipe. Alumina is much less volatile than silica; but it oftener undergoes ebullition.

M. Gaudin has since tried the temper and relations of the rock crystal, and has obtained unexpected results. If a drop of melted crystal fall into water, far from cracking and flying to pieces, it remains liquid, and furnishes good lenses for the microscope. When struck by a hammer, the instrument rebounds, and the lump will sink into a brick rather than break; its tenacity being such, that pieces can be detached only as splinters. It resembles steel in elasticity and tenacity. Siliceous compounds act nearly in the same way as rock crystal. The sandstone of pavement spins off like it, with this difference, that its threads, instead of being limpid, are pure white, nacreous, silky, and chatoyant, in a singular degree, so that they might be mistaken for silk; and the globules, to a certain degree, have the aspect of fine pearls, since they will possess the hardness of annealed rock crystal, instead of that of a calcareous compound. The emerald threads well, and its threads, which scratch rock crystal, are more tenacious than crystal threads. By the use of his oxy-hydrogen blow-pipe, he has also succeeded in melting crystals of aluminum and silex, such as the white sapphire and the ruby. After vain attempts with compounds of silex and aluminum, precipitated with their coloring matter, he employed a mixture of ammoniacal alum, or potassic alum, with three or four hundredth parts of chromate of potassium. These two salts ground together with a little water, formed under the action of increasing heat a transparent liquid, which was afterwards condensed into a friable porous paste. He hollowed out this paste into the form of a crucible, with which he capped his blow-pipe, and then blowing upwards, had found the interior of this crucible become studded with a multitude of exceedingly small rubies, of beautiful color and the finest water. Finding his blow-pipe too small, he made another one of a block of platina; and, by means of this, he succeeded in melting and spinning out rock crystal as easily as glass. He found that silex in a state of fusion is one of the most ductile substances in nature, and that the faculty of spinning glass depended on the quantity of silex it contained. It did not crystallise on cooling, but was very volatile; this hindered him from obtaining globules of more than three millimetres in diameter. He, however, spun out threads of silex so thin and fine, that they admitted of being tied in a knot, and had an iridescent appearance; they were so light, too, that the wind

easily carried them away; and a quantity of them could be rolled up in the fingers, looking like cotton. Threads of pure quartz were always cylindrical and transparent; those from sandstones and millstones were opaque, and had a nacreous appearance. Beryl and emerald did not yield threads so well as other silicious stones; but from the opaque color of the threads of emerald, he inferred that a mixture of emerald and sandstone would melt down into artificial pearls of great hardness. Aluminum he found to be deprived of all viscosity, and hence it was impossible to spin threads from the ruby, or from Syrian garnet, topaz, fluorure of calcium, (fluor spar), or the sandstone of Fontainebleau (Paris paving-stone). He had made from melted quartz some admirable microscopic lenses, and pivots for mariners' compasses; he had also drawn out sticks of quartz applicable to tools for burnishers and watchmakers.

BUHL WORK.

BUHL WORK is the art of inlaying in brass, silver, ivory, tortoiseshell, &c. and, if well executed, has an admirable effect. It was introduced into this country some years since, and is now brought to a state of perfection which equals any thing of foreign manufacture. Inlaying, as it is termed, that is, with fancy woods, has been too long in use to require any particular directions; buhl work is nothing more than inlaying in metals, turtle or tortoiseshell, ivory, or the like; and the chief difficulty seems to be in the method of cutting out the pieces for inlaying, and of introducing them in a proper manner as a veneer or inlay to the work.

To prepare Shell and Brass ready for cutting out.—Being furnished with a thin piece of brass, of the thickness of the veneer, or as thin as can be conveniently worked, make the faces on both sides rough with a coarse file, or tooth plane; take also a veneer of shell of the dimensions requisite, tooth that also; then warm your plates and veneers, pass a coat of glue first over a plate of brass; place over that a thin sheet of paper; glue that, and place your shell veneer on the top; place them between two smooth and even boards, either kept down by a heavy weight, or squeezed tight together by hand-screws; let them remain till dry, and they will adhere together sufficiently for the following purpose.

Cutting out the Pattern.—Draw the pattern on your shell; if not sufficiently plain, paste a piece of paper on its surface, and let it dry, on which draw your design; being now provided with a bow-saw, the blade of which is very thin and narrow, such as may be made with a watch spring, cut into about six strips, and the stretcher of the frame at a sufficient distance from the blade to enable you to turn in any direction, according to your pattern, and all made extremely light, begin by making a small hole in your veneer in a part where it will not so much be observed, (unless the pattern comes quite out to the edge,) and insert your saw; then very carefully follow the lines of your pattern till it is all cut through; you will then have two pieces, which may be separated by exposing them to steam or warm water; then take the two corresponding pieces, one of brass and one of shell, and when glued together, according to the following direction, you will have two veneers, the counterparts in pattern with each other, only where the brass is in one, the shell will be in the other.

To Glue up the Patterns.—Take two boards of

sufficient dimensions, and heat them before the fire; rub them well with tallow to prevent the glue sticking to them; then take a sheet of paper, on which lay your veneer, and having well rubbed some strong glue into the vacancies where the pattern is to be inserted, put it carefully in its place, rubbing it down with a veneering hammer, over which place another sheet of paper; place the whole between the hot boards, and press or screw them together with hand-screws; let them get quite dry, they will come out quite clean from the boards, and appear as one piece of veneer; you may then scrape the paper clean off, it is then ready for laying, or applying to your work.

Laying the Veneer.—Having made your work perfectly level with a tooth-plane, apply to your veneer a strong glue, and lay it on your work; then with a hot board, termed a caul, fasten it down by means of hand-screws, and let it remain till perfectly hard. It then only remains to be cleaned off and polished. The method here given for tortoiseshell is equally applicable to woods of two different colors.

MEMORANDA.

Discovery of Mummies at Durango in Mexico.—A million of mummies, it is stated, have lately been discovered in the environs of Durango, in Mexico. They are in a sitting posture, but have the same wrappings, bands, and ornaments as the Egyptians; among them was found a poignard of flint, with a sculptured handle, chaplets, necklaces, &c., of alternately-colored beads, fragments of bones polished like ivory, fine worked elastic tissues, (probably our modern India rubber cloth,) moccasins worked like those of our Indians, bones of vipers, &c. It is unknown what kind of embalming was used, for the mummies above mentioned, or whether they were preserved by nitrous depositions in the caves where they were found. A fact of importance is stated, that necklaces of a marine shell are found at Zacatecas, on the Pacific, where the Columbus of their forefathers probably therefore landed from Hindostan, or from the Malay or Chinese coast, or from their islands in the Indian Ocean.

Inlaid Marbles.—A mode of ornamenting marbles has recently been brought into use in Paris.—It consists in etching, by acids, deeply into the marble, various designs upon properly prepared bituminous ground. When the corrosion has gone sufficiently deep, the cavities are filled up with hard colored wax, prepared so as to take a polish equal to that of the marble when cleared off. Drawings thus made on black marble, and filled in with scarlet wax, after the manner of Etruscan, and certain Egyptian designs are said to have a noble effect, and are applied to tables, panneling, stoves, &c. &c.

Sheathing Steam-boilers with Lead.—A correspondent of the *Mining Journal* states that, "at a manufactory in Newcastle-on-Tyne, the boilers have been cased with sheet-lead, one-eighteenth of an inch in thickness, and weighing four pounds to the foot; and that the amount of the radiated heat is thus so much diminished, as to be equal to a saving of 17 per cent. in fuel. The average consumption of coal, by these boilers, previous to the adoption of this plan, was 60 cwt. per day, but now 50 cwt. is found to be amply sufficient; therefore a positive advantage is obtained of 10 cwt. per day, which is one-sixth, or 17 per cent."

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Fig. 1.

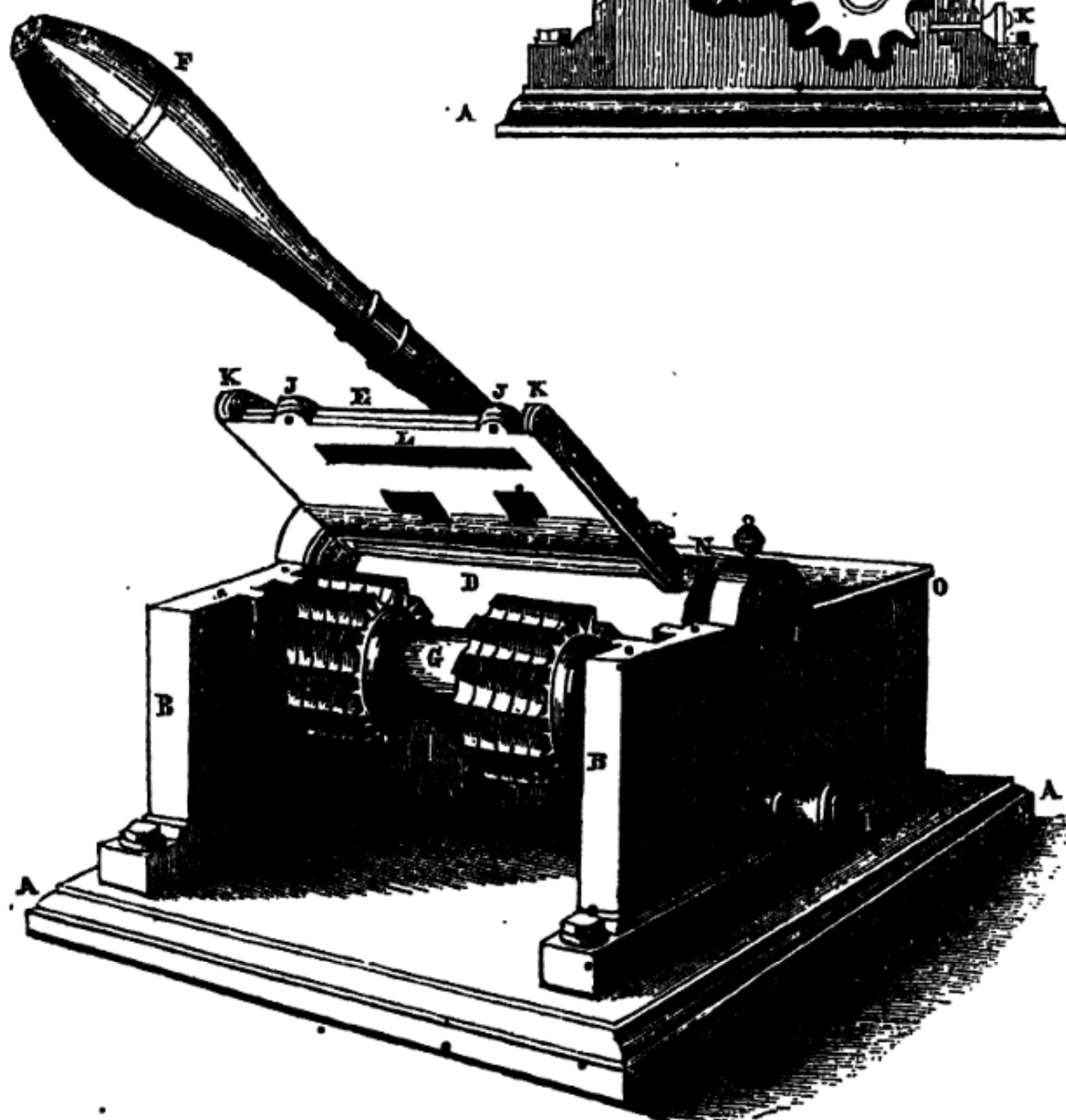
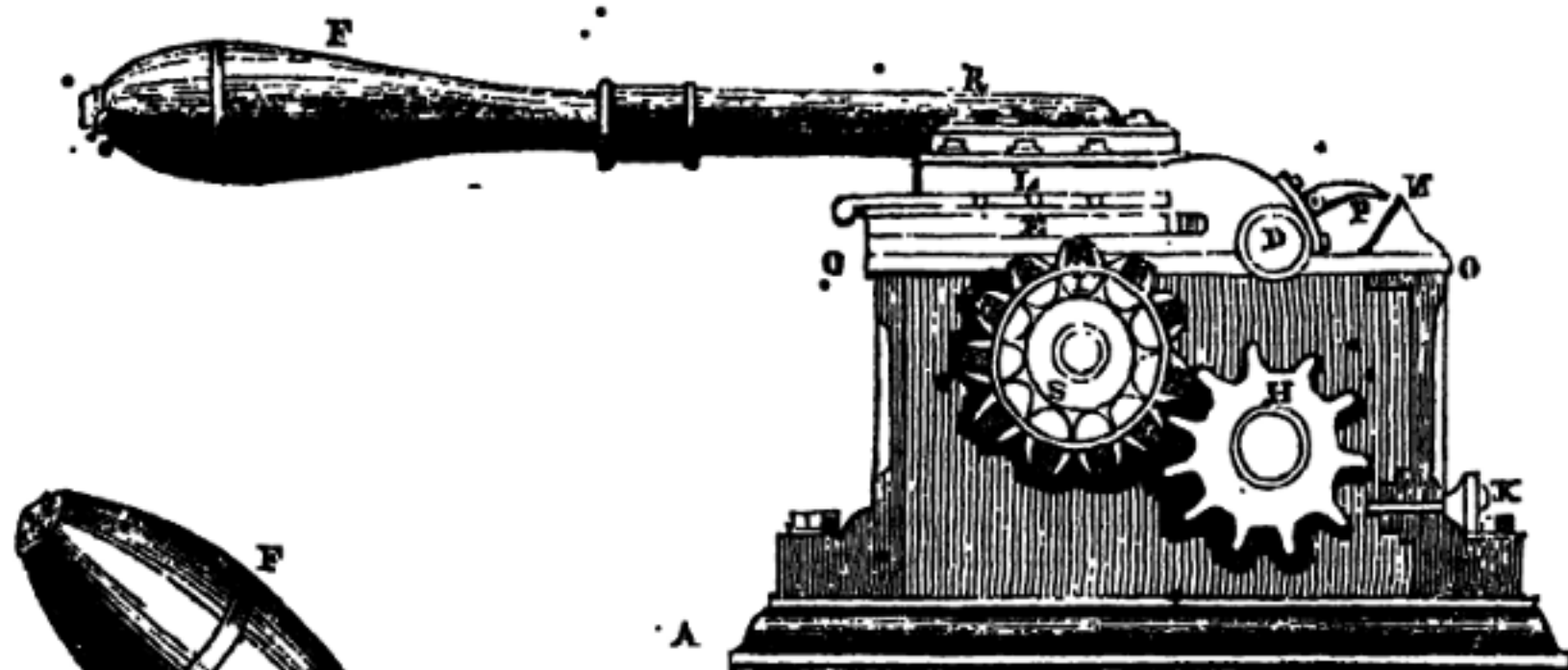


Fig. 2.

BRAMAH'S BANK-NOTE PRESS.

BRAMAH'S BANK-NOTE PRESS.

It was formerly the custom in the Bank of England to fill up the number and dates of their notes in writing, till the year 1809, when the machine invented by Mr. Bramah was adopted for this purpose. By this contrivance, the numbers and dates were inserted not only in a more uniform and elegant manner, but the labour was diminished to less than one-sixth of what it was before.

The copper-plates from which the words of the notes are printed are double; that is, they throw off two notes at a time upon one long piece of paper. This piece of paper, containing two notes, is then put into the machine, which prints upon them the number and dates in such a manner, that the types change to the succeeding number, and that the whole operation is performed without any attention on the part of the clerk. If one of the notes, for example, is No. 1, No. 1, and the other on the same paper No. 201, No. 201; when these are printed the machine alters itself to No. 2, No. 2, and No. 202, No. 202; and in printing these, the types again change to No. 3, No. 3, and No. 203, No. 203. The date and the word London are cast in stereotype, and each machine is furnished with one of these for every day in the year, and they of course are changed every day.

The Bank of England has upwards of 40 of these machines, the greater part of which are in constant use. It was formerly considered sufficient labour for each clerk to fill up the number twice repeated, 400 notes per day; but since the introduction of the machine, one clerk has printed 1,300 double notes, which are equal to 2,600 single ones; for though in the machine the double notes do not require more labour than single ones, yet to fill up the blanks by writing would occupy twice the time.

The mechanism by which this is effected is extremely ingenious, and the principle is not limited to the numbering of notes, but is equally applicable to the purpose of printing any series of numbers which require continual alteration. We have represented one of these machines, which is not, however, precisely the same as those in use, being only a single one, and adapted for printing one note at once; but we have only to suppose it extended to twice the length, and furnished with a double set of types, in order to fit it for printing two notes at the same time.

In the Figures, a perspective view of this machine will be found, and a section of its parts, in both of which the same letters of reference are employed. A solid piece of mahogany, A A, forms the base of the machine, and to this two iron plates, B B, are screwed, forming the sides of a box, the front of which is removed in Fig. 2, to exhibit the interior, and the back is concealed between the mechanism. Across this box an axis, D, is placed, having its pivots fixed into sockets which are fastened in the sides of the frame, as is evident from the figure. This axis carries the tympan E, which gives the pressure to print off the note attached to it by screws; and a lever F, is also fixed to the axis, by which the operator forces down the tympan. The moveable types, in which the principal novelty of the invention consists, are fitted into a series of brass circles, mounted upon an axis G, extending across the centre of the frame. These circles are sufficiently pointed out in the perspective view, by the numerals on the types fixed in them; they are ten in number, arranged in two lots of five each.

Each circle is divided into eleven parts, and at each a rectangular notch is cut, to receive the types 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and a blank type. Five of the circles, thus prepared, being placed side by side, upon a fixed axis, G, on which they revolve freely, are sufficient for printing any number less than 100,000; because, as the circles can be turned about on their axes independent of each other, it is obvious that any combination of the above figures may be produced, by bringing them to the highest point of the circle, which is the situation in which they are to be placed when an impression is to be taken. This will be more easily understood, if we consider that the brass plate which covers the circles is put on its place. This brass plate has two apertures through it, to receive the two series of types which project up a little above its surface when at the highest. In Fig. 2, this plate is removed to exhibit the interior mechanism.

The circles are made to revolve by means of wheels, H, upon an axis called the back axis, parallel to the axis of the circles. The end of it is seen at I, Fig. 2, projecting through the frame, and it carries three of the wheels H, two of which are at the same distance apart as the two series of figure circles to which they apply; the third wheel is placed at an intermediate distance between the other two, and is acted upon by a catch or pallet P, Fig. 1, attached to the axis of the tympan, by means of a joint, in such a manner that it will strike against the highest tooth of the wheel H, and turn it round one tooth. When the handle is lifted up rather beyond the perpendicular, a stop, O, Fig. 2, upon the axis, meeting a projection O, Fig. 1, on the cover of the box, prevents it from moving farther; but when the handle is returned down the position of the Fig. 2, the pallet, though it again meets the tooth of the wheel, gives way upon its joint, and passes by without moving the wheel. In this manner it will be seen, that every time the handle is pressed down to take an impression, in raising it up again to place a fresh paper upon the tympan, the pallet moves the wheels H one tooth, and as the teeth of these wheels engage the teeth of the figure circles, a similar motion is communicated to them, bringing a fresh number beneath the tympan, ready for printing.

It is to be observed, that the wheels H are of such a thickness, as to engage only one of the five type circles at once, and their distance from each other is such, that they take the same circle in the one series as they do in the other. Now, by moving the back axis a small quantity endwise, it is obvious that the wheel H can be brought to act upon any of the five circles, or be placed in such a position as to be clear of them all. It is for this purpose that the head I, Fig. 2, comes through the frame of the machine; for by means of this the axis can be moved on end, and by proper marks upon it, it may be set to any of the five circles. In these positions it is confined by a semicircular clip, which enters grooves turned round on the axis, and deprives it of longitudinal motion, unless when the clip is raised. This can be done by a nut coming through the back of the frame at K, Fig. 1. It has a short lever on the inside of it, which, when the nut is turned round, raises up the clip, and releases the axis while it is set to the required circle, and the clip being let fall into the proper groove, confines it from any farther motion.

In order that all the circles may stop at the exact point, when the figure is at the highest, and consequently, when the surface of the figure will be

horizontal, an angular notch is made on the inside of the figure circles, in the intermediate spaces between each figure; and at the lowest points of the circle O, Fig. 2, a moveable pin is fitted into the fixed axis, with a spring, which gives it a continual pressure downwards. The end of the pin is formed spherical, and well polished, so that when the circle is turned round it is forced into its hole in the axis; but when another notch in the circle presents itself, the pin presses out into it, and retains the circle with a moderate force in its proper position, until the raising of the tympan, as before described, overcomes the resistance of the pin, and turns the circle round. By this contrivance the types always arrange themselves to a straight line, after being turned round, without which the impression would have a very disagreeable and irregular appearance. The tympan E, Fig. 1, is composed of two parts; a solid brass plate, against which a few folds of cloth are placed and secured by the second part, which is a brass frame covered with parchment, and attached to the former by four screws, two of which appear at J J, in Fig. 2.

The brass plate of the tympan is fastened to the leaf L, Fig. 1, projecting from the axis by means of six screws. Two of these, only one of which can be seen in the Figure, tend to throw the tympan from the leaf; while the other four, which are arranged one on each side as the two former draw the tympan in and leaf together. By means of these screws thus acting in opposition, the tympan can be adjusted so as to fall exactly parallel upon the type, and communicate an equal pressure to all parts of the paper, which is held against the tympan by means of a frisket of parchment stretched on a frame which surrounds the tympan, and is moveable on joints at K K, Fig. 2. The frisket is cut through, as is represented by the shaded parts in Fig. 2, in order to expose the paper where it is to receive the impression of the figures, and the No. before the figures, and also the impression of the date, year, and place. The type for these are formed in stereotype, and fastened down upon the surface of the brass cover O, the piece containing the day and month being changed every day. In order to find the proper position which the paper should occupy upon the tympan, two fine pins are fixed to project from it, and are received into holes made in the brass cover; two dots are printed upon the note from the copper-plates, and the pins being put through at these dots, ensure the figures, &c. coming on their proper places.

The manner of using the machine is as follows: suppose the back axis put so far on end as to be detached from all the circles; the figure circles arranged by hand, so that the blanks are all uppermost; and the proper stereotypes put in for the date. The back axis is then first set, so that its wheels H may take the first five circles towards the right hand, and by moving the handle down almost to touch the type, and returning it up again, the pallet moves the wheels H, and turns the two right-hand circles, bringing up Fig. 1. The clerk now inks the type with a printer's ball, opens the frisket sheet L, Fig. 2, on its hinges, and places the note (already printed on the copper-plate press) against the tympan, the proper place being determined by the two pins, and the dots printed on the note, as before mentioned. He now shuts up the frisket sheet, in order to confine the paper and keep it clean, except in the places where it is to be printed; then by pressing down the handle F, the impression is given; and on lifting it up again it moves the circles and brings up figure 2. The note is now re-

moved, a fresh one put in, and so on, the figure always changing every time.

During this operation the two right-hand circles act as units, and advance one each time; when 9 are printed in this manner and 0 comes up, the handle is moved twice successively without printing, which brings up a blank and then a 1. The back axis is moved, to act upon the second circle upon the right hand, which now becomes the units, the first circle representing tens; by moving the handle, without printing, figure 1 in the second circle comes up, making 11, the next time 12, and so on to 19. The first circle is now put forwards by hand, bringing up 2 and 0, on the second 20, then moving the handle to pass the blank, produces 21, 22, &c. to 30, when the first circle is again advanced, bringing up 4; in this manner the business proceeds to 99. The back axis is now shifted to the third circle, which becomes units, the second tens, and the third hundreds; the 0 and blank of which are advanced to bring up 1, 0 is brought up in the second; and the machine itself brings up 0 in the third; after printing this it changes to 101.

The process now continues through the successive hundreds in the same manner as before till 999. The back axis is now shifted to the fourth circle, and the three first must be advanced by hand when they require it. At 9999 the back axis is shifted to the fifth circle, and it will serve to 999,999, beyond which it is not required to print.

COLLECTING SHELLS.

SHELLS can only be expected perfect, when they are found with the animal alive in them, or taken by the dredge or trawling-net from their native beds; fine specimens are sometimes found adhering to fishermen's lines or nets. After violent storms many excellent shells are often found on the beach, driven from their beds by the agitation of the waters; on such occasions perfect specimens are often to be met with. The conchologist ought, therefore, to avail himself of every opportunity of walking along the beach, immediately after the tide begins to recede. The greater part of shells seen in collections are picked up dead on the beach, and are therefore seldom very perfect, as they are tossed to and fro by the waves, and either worn or broken; should they even be driven beyond the reach of the tide, in this situation they are exposed to the continual heat of the sun, by which their colors become faded.

River and land shells are mostly thinner than those of the sea: though this is by no means a general rule, as the paper nautilus, some of the helices, and pinnæ, are extremely thin and brittle.

Several of the land shells are very beautiful, and elegant in their form, particularly those found in tropical climates. In Africa, they grow to an amazing size, and would be very unwelcome guests in our house gardens, as they commit great havoc among the esculent plants. The *achalina zebra* of Africa is very frequently found seven inches from the apex to the base. A few of our own land shells are very beautiful; but from their being familiarized to us, we look on them with the greatest indifference; for example, the helices, pomatia, arbustorum, and nemoralis.

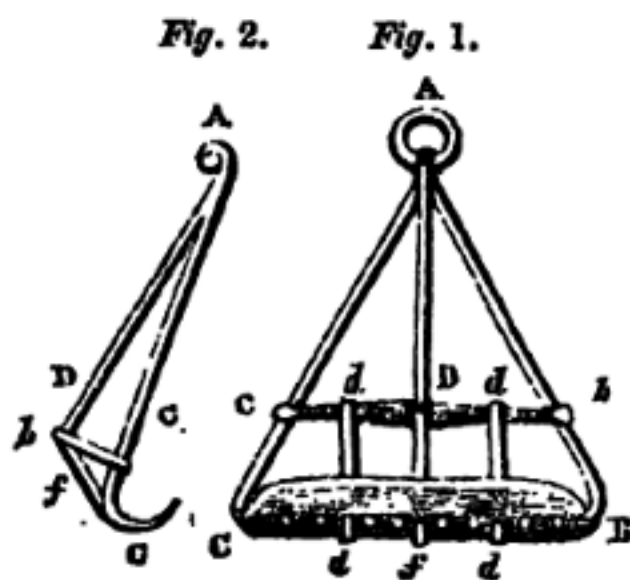
Some authors affirm, that the cyprea tribe abandon their shells every year, to form new ones of a larger size; but this seems rather a doubtful circumstance, and has not yet been satisfactorily explained.

When shells are found with the animal alive, hot water should be poured upon them, when the creature may be easily taken from bivalve shells; but caution is required in the univalves; as should part of the animal be left in the volutions, it will be almost impossible to extract it; and the smell becomes very offensive.

Marine shells are to be met with on almost every shore in the known world, but those of warm climates have in general a finer polish, and exceed all others in point of coloring.

The instruments used in procuring marine shells are three, namely, the dredge, gangui, and the rake. The latter two are, however, not so important as the former, which we shall first describe. It ought to be in the possession of all travellers, and by using it in foreign coasts, many beautiful and unknown shells might be obtained; and these in the most perfect condition.

The Dredge.—There is no instrument like the dredge, in point of general utility. It is much used for fishing oysters, and acts upon the bottom of the sea almost like the rake. No naturalist, who lives on the sea-coast, should be without a dredge; and to those travelling in foreign countries, in search of natural objects, it will be found of the utmost utility. It is to be much deplored that so few naturalists think of possessing themselves of this very useful instrument; as by its aid many remarkable animals might be discovered, which inhabit the mighty deep. Indeed we may be said not to know any thing of the marine natural history of foreign lands, as few or none of them have been explored by the dredge. The following is a representation of that instrument.



To have a clear idea of the dredge, and the parts which compose it, we must imagine a circular bar of iron, forged in the shape of an almost equilateral triangle, A, B, C, of the above figure, whose two extremities are joined at A. To form the summit or point of the triangle, each of the sides should be above five feet. The two branches, A B, and A C, are rounded and bent, as they approach the base of the triangle. The base, B C, is forged into a plate, six inches in breadth, with a sharp cutting edge in front, turned upwards at an angle of about sixty degrees. The back, or that part opposed to the edge of the plate, is an inch thick. By means of the curvature, δ B, δ C, of the two lateral branches, A B and A C, the edge of the plate, B C, is brought forward, and a little turned to the side of the summit, A, as may be seen in the profile of the dredge, A C. This edge makes, with the plane of the triangle, contained between the straight parts of the two descending branches, A B, A C, an angle of about sixty degrees.

There is a large iron ring attached to the summit A; when, by means of a rope passed through this ring, the dredge is dragged along the bottom of the sea, the edge B C, which is turned to the lower side, next the bottom, rakes it strongly, and detaches from it all the bodies which adhere to it; but it is not enough that these bodies should be detached from the bottom of the ocean; they must also be retained, and raised by means of a net.

This net, attached to the dredge, and which follows it at the bottom of the sea, in order that it may receive within it the bodies that are detached, has the form of a bag. The lower part of this bag, which is intended to drag along the bottom, should be made of untanned hide, so as to resist the friction. The side next the plate should consist of straps of leather, crossing each other like a net; which are attached to eight holes in the back of the plate, B C, which may be seen in Fig. 1. This plate is pierced with eleven holes, but three of them are intended for the reception of three bars, whose use will afterwards be explained.

The upper part of the net is attached to a rod, δ c, which crosses the triangle, A B C, parallel to the plate B C, which is distant from that plate about two feet: this rod is round, and nearly two inches in diameter; the two extremities terminate in a flattened end, perforated to receive the two ascending branches, A B, A C.

The curvature of this rod removes it from the plane of the triangle, δ A c, in a way contrary to that in which the base of the plate, B C, is removed from it, by means of the curvature of the two ascending branches, A B, A C, at their inferior extremities; and these removals in a contrary way, keep the bag always open, of which the edges have been attached, as we have said, one end to the back plate, B C, and the other to the transverse rod or bar, δ c.

This rod must be firmly fixed in its place; for this purpose it is a little flattened, and pierced in its middle, D, with a hole. A bar, A D, which comes from the summit, A, of the dredge, and which is also flattened and pierced with a hole at its extremity D, is joined, by means of that extremity, to the middle of the rod, δ c, on the concave side, so that the two holes are adapted to each other. The extremity of a small cross bar of iron, Df, is made to pass these, which issues by the other side of the rod, δ c, and the bar, A D. The same cross piece of iron, Df, is attached, in a similar manner, by its other extremity, f, which is made to pass, that it may be afterwards bent, through one of the holes, with which the back of the plate, B C, is pierced.

This plate, as we before mentioned, is pierced with eleven holes, of which eight only are employed in giving passage to the meshes of the net or bag. These holes are arranged two and two together: an idea of their arrangement, and the use of the three others, may be learnt by inspecting Fig. 1; that in the middle serves to attach the cross bar, Df. The two others serve to attach in like manner, two similar cross bars δ d, δ d, Fig. 1, which strengthen the whole machine, and on which the other extremity is attached to the rod, δ c, by a kind of hook, which embraces that rod.

The bar, A D, and the cross bar, Df, are inclined to one another. By means of this inclination, the bar A D, through which passes the cross bar Df, is strongly fixed to the rod δ c, from which it can be removed only by being elongated. This bar, A D, is a little less thick than the two ascending branches A B, A C; they are, however, nearly $\frac{1}{2}$ an inch in

diameter. The three branches, A B, A C, A D, unite again at the summit of the dredge, where they are welded together so as to make only one, whose extremity is bent to embrace the ring, as seen at A, Figs. 1 and 2. The common oyster dredge is smaller than that which we have described, and of a lighter make.

We have still to describe the manner in which this instrument is used for the fishing of shells. A cord is passed through the ring attached to the point of the dredge, another cord is attached to the middle of the rod, *b c*, by a knot which embraces the rod *b c*, the perpendicular branch A D, and the small cross-bar D *f* at the point where they unite. When the boat has reached the place of fishing, the dredge is thrown out at the stern in the same manner in which an anchor is thrown out, the last named cord serve to keep the dredge in its place, the plate being turned below till it arrive at the bottom of the sea, and to prevent it from being overturned by the way. When the dredge has reached the bottom, it is hauled along by rowing and sailing. Should the dredge be stopped by any rock or irregularity at the bottom, the rope attached to the ring should be pulled. When the bag is supposed to be full, the dredge is drawn on board by the capstan, and the bag is emptied of its contents.

Different species of seaweed are frequently covered by minute shells; weeds should always be carefully examined. Many of the smaller and microscopic shells are found at high water mark among the fine dross and drifted fragments of shells: this sand should be brought home and examined at leisure. To facilitate the process, a small wire-cloth-sieve should be made of about six or seven inches square, and all the sand sifted through it; and the shells left.

The Gangui.—This is the most simple apparatus for fishing shells. It is a large net in the shape of a bag. The mouth of this bag is kept open while at the bottom of the sea, by means of a stick placed transversely, keeping the margins apart from one side to the other. This stick is equal to the diameter of the aperture of the bag, and as it is placed horizontally, it divides that aperture into two halves, the one inferior, and the other superior. The whole circumference of the lower part is furnished with small pieces of lead, whose weight draws it down. The circumference of the upper part is provided, on the contrary, with small pieces of cork, which raise it up; thus the bag remains always open at the bottom of the sea. This bag is dragged by means of a rope which attaches it to a boat, the motions of which it follows. The lead with which the lower part of the aperture is loaded, causes it to drag strongly along the bottom of the sea, the shells and marine plants of which are pulled off, and enter the bag as it is moved forward.

The Rake.—In many cases, the gangui has not sufficient power to detach those shells which adhere strongly to the rocks at the bottom of the ocean; in which case, the rake will be found an efficient instrument.

The rake is composed of a cross piece of iron, armed with teeth, and attached to a long handle, of a similar form to the rake used by gardeners, except that from the two extremities of the cross iron proceed two iron branches, which are attached to the handle, and which form, with the cross piece, a kind of semicircle. This semicircle serves for attachment and aperture to a net, in shape of a bag. This rake is fixed by the end of a handle to a rope, by means

of which, fishers, in a boat, draw it in by the help of a capstan. The teeth of the rake drag along the bottom of the sea, and detach the marine bodies which adhere to it; these are received into the net, by means of which they are brought up to the surface.

Land shells inhabit nearly every country of the globe. They are found in woods, hedges, and gardens, where they take up their residence either in the hollows of trees, crevices of rocks, holes in old walls, the roots of hedges, under stones, amongst moss; or adhere to the branches and stumps of trees, and under the shade of leaves, or amongst nettles, or other weeds. It is during the day that they retire to those situations, and in the evening they are met with crawling abroad: or in the day time when the weather is moist and rainy.

Fresh water shells are to be met with in almost every lake, pond, river and ditch, either lurking in the mud at the bottom, or crawling on leaves, or on the sides of the lakes, &c. For ordinary purposes, a tin spoon must be used to search for them; this is like the head of a dredge box, of four inches and a half diameter, perforated with numerous small holes, not exceeding the sixteenth part of an inch calibre. To this must be attached a handle for the reception of a walking stick or other piece of wood. With this spoon the conchologist must rake along the surface of the mud and sand at the bottom of ditches, rivulets or ponds, and having brought a quantity to the surface, the mud must be washed entirely away, and the shells, if there are any, will remain behind.

For the *Anodonta cygnea*, and other large species, which burrow deep in the mud, a different sort of net is necessary. This consists of an iron triangle of twelve inches by seven at the base, to which a hollow upright hurdle is affixed, and in this is inserted a pole of sufficient length to reach the bottom. It must be firmly screwed to the handle. A net of twine or hair-cloth is attached to the triangle. The point of the triangle should be sharp, so that it may the more easily penetrate the mud, through which it must be drawn in situations where shells are likely to exist.

CHEMICAL AND MEDICAL PROPERTIES OF SILK.

SILK is powerfully acted upon by nitric acid. If two drachms of this acid are mixed with a pint of alcohol, and silk, either raw or bleached, be immersed in it, and kept in digestion exposed to a moderate heat for twenty-four hours, the silk becomes of a dull yellowish brown, which, after it has been washed with soap, rinsed, and dried, turns to a fine golden yellow color, which is very permanent. Concentrated nitric acid being distilled off silk, and the remaining liquor partially evaporated, oxalic acid is obtained: if the evaporation be pursued still farther, the residue will yield, together with a small portion more of oxalic acid, a quantity of yellow crystals, not in the slightest degree acid, but intensely bitter, and which stain the skin of a deep yellow color, not easily removed. This curious substance was discovered by Walter, and was called by him "the bitter principle." He supposed that its production always results from the action of nitric acid on animal matter. These crystals, when examined through a magnifying glass, appear to be composed of truncated octohedrons.

If the remaining liquor be previously saturated with potass and evaporated, another yellow silky salt separates, which detonates on burning coals like nitre, and appears to be a triple combination of the before-mentioned bitter substance with nitrate of potass.

The water wherein the cocoons are placed to prepare them for reeling, quickly acquires from them so much of the resinous matter as to be more viscid than the strongest soap lather. Chappe found that he could inflate this water into bubbles or small balloons, which were far more permanent than any formed of soap and water, and which equally exhibited the prismatic colors. The texture of these bladders was so tenacious, as to render them impervious to the most subtle gas: Chappe filled several of them, whose diameter did not exceed three inches, with hydrogen gas, and the little air balloons remained unbroken and floating in his apartment for considerably more than twenty-four hours. All cocoons are not sufficiently glutinous for this purpose; with those which are of a very deep yellow the experiment will not succeed: such are supposed to be produced by the worm in a peculiar state of disease, which state is yet by no means uncommon.

According to Westrum, silk, when acted upon by chlorine, either in the gaseous form or diluted in water, instead of being bleached, as cotton or linen would be, always becomes of a yellow color, and loses part of its solidity. The caustic alkalis corrode and dissolve silk, which gives by distillation the results usual with animal substances.

Neumann found that but few materials afforded an equal quantity of volatile alkali. Tounefort observes that it contains more than hartshorn, as he obtained from fifteen ounces of silk two drachms of volatile salt: this, which was called the spirit of raw silk, when rectified with some essential oil, was the medicine formerly celebrated under the name of "Guttæ Anglicanæ," or English drops. The volatile alkali obtained from silk was then supposed to be of a different nature from that contained in any other substance, and it consequently was held to possess different virtues peculiar to itself. So salt of tartar, and sub-carbonate of potass, were for a long time considered to be, and were used as two separate substances. The chemical philosopher had not then learned to generalise, and could not understand that the same substance, differing in no one particular as to its nature and properties, could be obtained from many apparently wholly dissimilar bodies.

Before the discoveries of chemistry had arrested the fanciful flights and annihilated the quaint distinctions of the druggist, his catalogue presented a curious nomenclature, which is now acknowledged to have been founded on ignorance and prejudice. The light of science has since pierced the veil, and has revealed many of the laws of nature in all the beautiful simplicity of their elements; dispelling much of the complicated mystery and vague obscurity which then enveloped the ill understood practice of pharmacy.

A silk covering of the texture of a common handkerchief is said to possess the peculiar property of resisting the noxious influence and of neutralising the effects of malaria. If, as is supposed, the poisonous matter is received into the system through the lungs, it may not be difficult to account for the action of this very simple preventive: it is well known that such is the nature of malaria poison, that it is easily decomposed by even feeble chemical

agents. Now, it is probable that the heated air proceeding from the lungs may form an atmosphere within the veil of silk, of power sufficient to decompose the miasma in its passage to the mouth; although it may be equally true that the texture of the silk covering may act mechanically as a non-conductor, and prove an impediment to the transmission of the deleterious substance.

We learn from Pommet's history of drugs, that silk was in his time used as a medicine, by reducing the pure part of the cocoon into a powder. His volume contains many copious directions for preparing this powder, and for duly and carefully separating the chrysalis from the part which he considered medicinal. Silk thus prepared has, as he affirms, "the virtues of cleansing the blood, making the spirits brisk, and the heart pleasant." Lemery, the editor and commentator of Pommet, adds, that the silkworm itself likewise possesses medicinal properties. According to his information, silkworms that had been dried into a powder and applied upon the head, which should be previously shaved for the reception of this plaster, were esteemed extremely efficacious in curing vertigo.

The imperishable nature of silk, even under circumstances peculiarly unfavorable to the preservation of animal substances, forms another of its qualities which is deserving of remark. Some years ago, the sexton of the parish of Falkirk, in Stirlingshire, upon opening a grave in the churchyard, found a riband wrapped about the bone of an arm, and which, being washed, was found to be entire, and to have suffered no injury, although it had lain for more than eight years in the earth, and had been in contact with a body which had passed through every stage of putrefaction, until it was reduced to its kindred dust.

RESISTANCE ON RAILWAYS.

THE resistance to the motion of a carriage upon a railway arises from two causes,—1st, from the friction of the several parts of the machine; and, 2ndly, from the resistance offered by the air and wind: the atmosphere equally opposes the passage of the stage coach, the track-boat, and the steam-boat; but the motion of these vehicles being comparatively slow, and the power required to overcome the friction encountered being very great, the resistance of the air is disregarded in their construction, but a very large proportion of the resistance upon railways is attributable to it, as the atmospheric resistance is supposed to vary in the square of the velocity: a higher velocity on a railway than 35 miles an hour has therefore been deemed inexpedient with the present engine powers: the expense attending any further increase of speed would also be very great. The average speed of the first class passenger trains upon public lines of railway varies from 20 to 30 miles an hour; there has been a few instances of an engine, with its tender, acquiring a high velocity—as 15 miles in 15 minutes. The effects of high winds upon a railway train is very considerable, particularly side winds, as they press the flanges of the wheels against the rails, thereby impeding their progress, and increasing the wear and tear much. Public lines of railway, (as the London and Birmingham,) are generally made 33 feet wide in excavations and 30 feet on embankments, the difference being caused by two drains, each 18 inches wide, which are required at the bottom of cuttings, one upon each side the line: the surface of the ballast-

ing or road is laid a little convex, to carry off the water; and two or three yards should be allowed on each side for fencing and ditching. The width between the rails is 4 feet 8½ inches upon the principal railways throughout the kingdom, (as the London and Birmingham and Grand Junction Railways—although it is made 7 feet upon the Great Western), and the intermediate space in the centre between the trackways is usually about 6 feet, and it is of similar width as the space between the rails upon some lines—as upon the Newcastle and Carlisle, and the Leeds and Selby Railways; and the side space, or the distance on the outside of the rails, is generally about 5 feet—as upon the London and Birmingham and Grand Junction Railways.

The motion of a train down an inclined plane has been generally considered to be uniformly accelerated; i. e. an increase of velocity takes place every second of time, being the speed due to the gravity of the plane, and the resistance due to the friction of the carriages only was calculated as being the sole check to the velocity: the effect of the atmosphere, or anything else which might produce a retardation, increasing with the speed, was wholly neglected, being considered of comparative trifling amount; but Dr. Lardner proved by experiments, that the degree of acceleration was gradually diminished as it run down the plane, instead of increased. The former theory would certainly hold good if there was no other resistance but that arising from the friction, and the speed would then be diminished by the amount of velocity destroyed by the friction of the train only. Now, as the force of gravity is well known, (also the effect produced by an inclined plane, of given inclination, in diminishing the intensity of same), finding the amount of resistance occasioned by the friction, is consequently an easy calculation, all other resistance being disregarded, or the acceleration due to gravity could be calculated, and the actual acceleration moving down the plane observed, the difference being supposed to give the retarding force due to the resistance.

According to this new theory of Dr. Lardner, if an inclined plane of sufficient length could be attained, the motion of a train would continue to be accelerated until a velocity was acquired, which would produce "a resistance from the air, such as combined with friction, would be equal to the gravitation down the plane;" upon such velocity being obtained, the moving weight being equal to the resisting force, no further acceleration would take place.

As it was thought that inclined planes of sufficient length were not accessible to try the accuracy of this theory, it occurred to the Doctor that the end would be equally attained by starting the train from the top of an inclined plane, at a considerable speed, as the acceleration it would receive while descending, added to the speed with which it started, might be expected to give that velocity at which all increase of speed would cease, and an uniform motion be maintained to the bottom of the plane; and this anticipation was realized by experiments, and an uniform gravitation or velocity was produced, which was regulated by the load; when the latter was increased the velocity was increased, its motion being accelerated for a short distance from starting, but at length becoming uniform in every case, the velocity diminishing with the steepness of the plane. It was found that the same general principle applied to trains of whatever magnitude. It was also ascertained by these experiments that the common estimate of the resistance upon inclines is erroneous, being taken

at the same as the resistance upon the level portions, or about $\frac{1}{100}$ th of the load; whereas it was found that the actual resistance at high speeds very considerably increased, compared with it when the motion was slow. The motion of a train for about 100, 200, or 300 yards, was found to give a very small degree of resistance, when started with little velocity, viz., from $\frac{1}{100}$ th to $\frac{1}{200}$ th of the load, thereby showing that the atmosphere was but slightly affected by the same, although it amounted to from $\frac{1}{50}$ to $\frac{1}{100}$ of the load, when the initial motion was very great. The state of the weather and the direction of the wind were also found to influence the motion of the train very considerably; a great portion of the force of the engine is also absorbed by the wheels of the carriages, owing to their velocity and their great number, they may be said to act against the atmosphere, and the air for some distance round them is also affected, and which forms part of the resistance opposed to the moving power. The uniform velocity above described was precisely the same upon the curves as upon the straight parts of the line, the former being of one mile radius: the Doctor therefore concludes, that curves of that radius have no perceptible effect upon the resistance. Dr. Lardner described his conclusions to be as follows, reserving to himself the power of modifying them when his experiments shall be all reduced.

1. That the resistance to a railway train, other things being the same, depends on the speed.

2. That at the same speed, the resistance will be in the ratio of the load, if the carriages remain unaltered.

3. That if the number of carriages be increased, the resistance is increased, but not in so great a ratio as the load.

4. That, therefore, the resistance does not, as has been hitherto supposed, bear an invariable ratio to the load, and ought not to be expressed at so much per ton.

5. That the amount of the resistance of ordinary loads carried on railways at the ordinary speeds, more especially of passenger trains, is very much greater than engineers have hitherto supposed.

6. That a considerable, but not exactly ascertained, proportion of this resistance is due to the air.

7. That the shape of the front or hind part of the train has no observable effect on the resistance.

8. That the spaces between the carriages of the train have no observable effect on the resistance.

9. That the train, with the same width of front, suffers increased resistance with the increased bulk or volume of the coaches.

10. That mathematical formulæ, deduced from the supposition that the resistance of railway trains consists of two parts, one proportioned to the load, but independent of the speed, and the other proportional to the square of the speed, have been applied to a limited number of experiments, and have given results in very near accordance, but that the experiment must be further multiplied and varied before safe, exact, and general conclusions can be drawn.

11. That the amount of resistance being so much greater than has been hitherto supposed, and the resistance produced by curves of a mile radius being inappreciable, railways laid down with gradients of from 16 to 20 feet a mile have practically but little disadvantage compared with a dead level; and that curves may be safely made with radii less than a mile; but that further experiments must be made to determine a safe minor limit for the radii of such

curves, this principle being understood to be limited in its application to railways intended chiefly for rapid traffic.

TERRESTRIAL AND CELESTIAL GLOBES.

(Resumed from page 36, and concluded.)

BESIDES the delineations on the surface of a globe, there are various appendages necessary for the solution of astronomical and geographical problems. One is a brazen meridian passing round the globe at right angles to the equator; at two opposite points of it are pivots in which the ends of the axis work, so that the globe can revolve within the meridian. One side or face of this meridian is graduated into 360 equal parts, or degrees (each of which is sometimes subdivided in large globes); and the graduation is generally such that in one-half of the meridian the numbers go from the equator towards the poles, and in the other from the poles towards the equator, to facilitate the performance of certain problems.

A more important appendage is the *horizon*, a flat circle of wood which engirdles the globe in a horizontal direction, intended to represent the boundary between the upper and under half of the earth or of the heavens. In the strictness of astronomical language, the horizon is an imaginary plane passing through the centre of the earth, and determining the rising and setting of the heavenly bodies. But in practice the horizon, or boundary between earth and sky, is not the true horizon, because one is referred to the surface of the earth and the other to the centre; hence the rising of a heavenly body above the *sensible* horizon is not coincident with its rising above the true horizon, and a correction of *parallax* is thence often required in observations. On the globe the wooden horizon represents the true horizon, and on its surface are delineated various divisions and circles useful in solving problems. Some globes have as many as seven different concentric circles marked on the horizon, viz.:—1. A circle of *amplitude*, graduated in quadrants from the east and west points respectively towards the north and south: the amplitude of a heavenly body is the distance in degrees from the east, at which it rises, and the distance from the west, at which it sets; in our summer the sun's amplitude is always north, and in winter always south. 2. A circle of *azimuth*, graduated in quadrants from the north and south points respectively towards the east and west: the azimuth of any object in the heavens is the distance from the north or south point of the horizon to a vertical circle passing through the object. 3. The thirty-two points of the compass divided into half and quarter-points. 4. The twelve signs of the zodiac, with the figure and character of each sign. 5. The signs divided into degrees, each sign comprehending thirty degrees. 6. The days of the month answering to each degree of the sun's place in the ecliptic. 7. The equation of time expressing the number of minutes which the clock is before or after the sun on every day of the year. According to the size and value of the globe, the circles delineated on the horizon include a greater or less number of those here enumerated, and offer more or less facilities for the solution of problems.

Some globes have on a particular part of their surface a kind of table, called an *analemma*. It is a narrow slip of paper, the length of which is equal to the

breadth of the torrid zone, and is pasted on some vacant place on the globe in the torrid zone. It is divided into months and days of the month in such a manner as to show the declination of the sun for every day of the year. Some of these *analemmas* are so contrived as to show the equation of time as well as the declination of the sun; and the purpose of them, as well as of some of the circles on the horizon, is to save the trouble of frequent reference to an almanac.

On some terrestrial globes there are lines radiating from some vacant spot at or near the equator, representing *rhumb* lines. These relate to a curious fact in navigation, that a ship, in traversing the ocean from one spot to another, cannot, by the aid of the compass, alone, take the *shortest* distance; it describes a curious curve, called a *rhumb*. This circumstance, however, does not in general occupy a place among problems solved by the use of the globes.

There are two or three appendages to which we have yet to allude. One is a brass quadrant of altitude, divided into ninety degrees, to be fastened on the meridian at the zenith of any spot, for the purpose of measuring altitudes, or indeed for measuring degrees on the spherical surface in any direction. A second appendage is the hour-circles, divided into twice twelve hours, and fitted on the meridian round the poles, which carry an index pointing to the hour. Lastly, we may allude to the compass, which is frequently attached to the stand of the globe, as a means of adjusting it to any particular position with respect to the north and south points of the heavens.

It will thus be seen that a very large number of data, connected principally with the diurnal and annual motion of the earth, are represented in some way or other on a pair of globes. The earth's axis, the poles, the equator, the tropics, the polar circles, the parallels of latitude, the meridians, the ecliptic, the pole of the ecliptic, the zodiac, the circles of celestial latitude and longitude, the sun's declination and right ascension, the first point of Aries, the horizon, with its graduations of azimuth and amplitude,—in short, nearly all the materials (if we may use such a term) from which seasons, night and day, &c., are produced, are delineated by some lines or symbols, either on the globe itself or on some of its appendages.

The purpose of these arrangements is, to afford a palpable and visible explanation of many circumstances connected with the motion of the earth, by which the student may form a more correct idea of the causes of these phenomena than by mere reading. To the practical astronomer globes are of little use. The nutation of the earth's axis, the precession of the equinoxes, the change in the right ascension and declination of the stars, the compression of the earth at the poles, &c., are altogether omitted in the construction and arrangement of globes; and even those phenomena which are represented cannot be given with anything like minute accuracy. If, however, globes be regarded as aids to the student, and as a means of determining roughly the phenomena of day and night, and of seasons, when particular nicety is not required, they then become very useful instruments.

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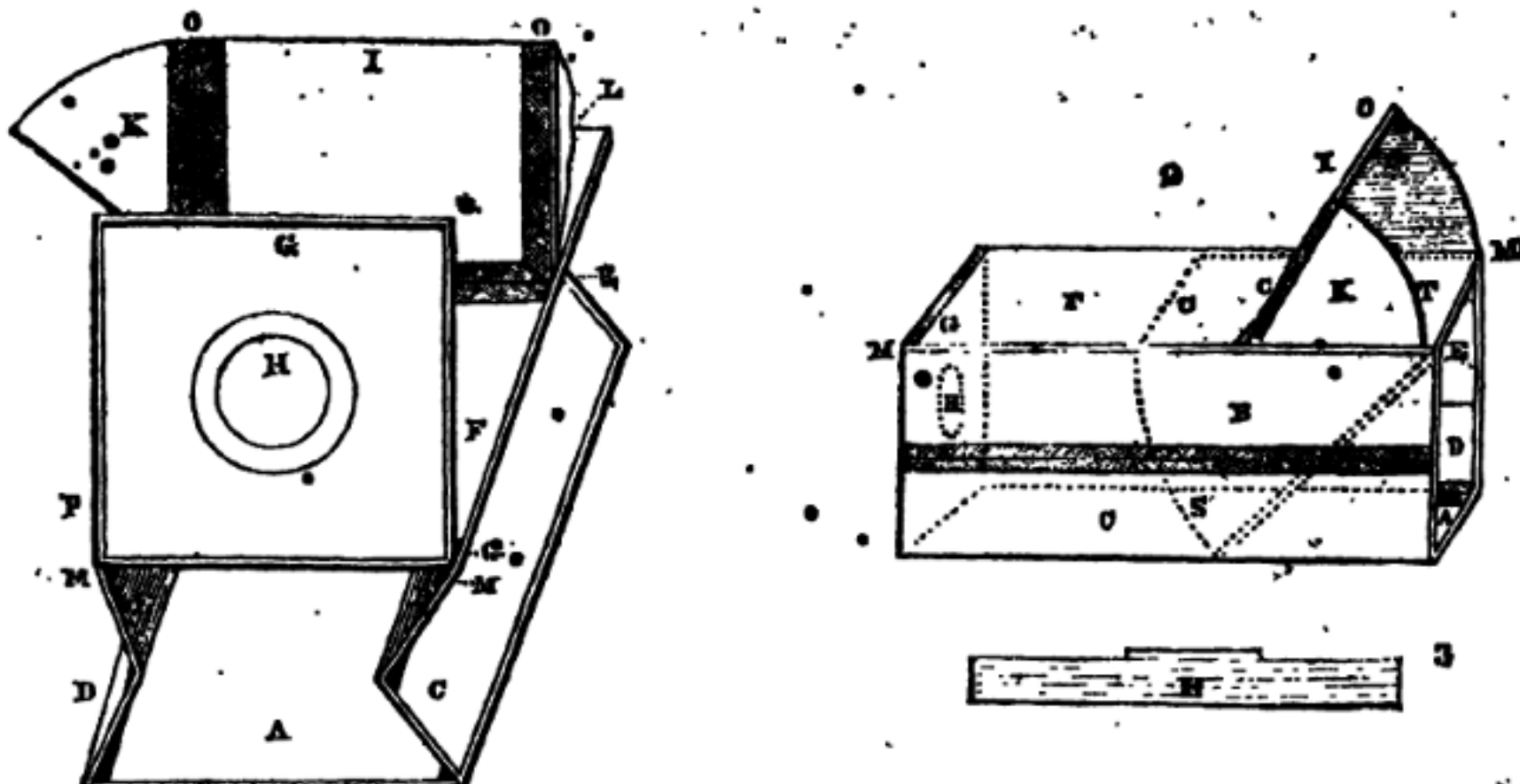
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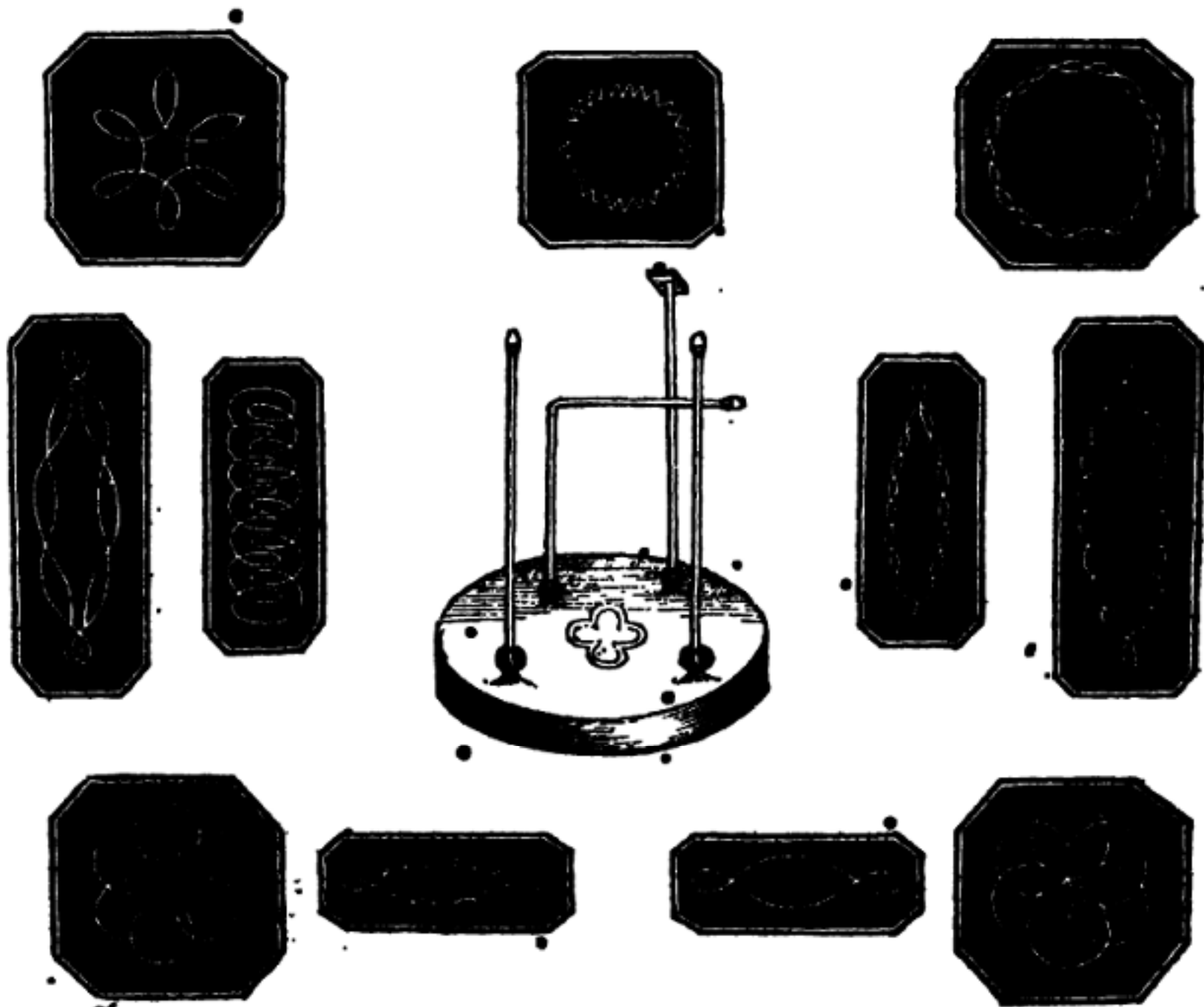
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NEW EDITION.

[1d.



POCKET CAMERA OBSCURA.



THE KALEIDOPHONE.

POCKET CAMERA OBSCURA.

(To the Editor.)

SIR.—I hereby transmit you the sketch, with description, of a newly-constructed camera obscura, more portable than any I have yet seen or heard of, and if worthy a place in your columns, insertion in them would be conferring an obligation on

Ipswich, April, 1842.

ÆGIDIUS.

*Description:—*The letters correspond in each figure. Fig. 1. A front view of the camera seen in perspective; A is the bottom, 3 inches in length, by $1\frac{1}{2}$ inch in breadth; F is the top, commencing from the front, 2 inches long, and $1\frac{1}{2}$ inch broad; below the top small slips of wood are firmly fixed as at M M, as deep as the wood used is thick; these slips continuing behind F for the length of 1 inch. B C and D E are the two sides of the camera, composed each of two pieces; the lower ones being 3 inches long and $\frac{3}{4}$ inch broad; the upper ones the same only deducting the depth of inches from the breadth of each. The lower halves C and D are affixed to A by hinges inside, as seen in the cut, and these to B and E by hinges outside at their junction; H and E are now joined to F, by hinges passing under M and M, and finishing under F. All the before-mentioned hinges are continued throughout the whole length of the box. G is the front of the camera, containing the lens II; it is exactly $1\frac{1}{2}$ inch square, of twice the thickness of any other part of the apparatus, and having a groove cut round its inner edge of the same depth and breadth as the thickness of the sides; C is now joined to the top by a hinge at G on the outer surfaces of G and F, a space being left, in the putting on of the hinge, between the outer edges of G and F, of precisely half the thickness of the front G, in order to give it play in its future motions; being careful that nothing projects beyond the outer surface of G. I is the screen for the prevention of the ingress of light; it is placed at the distance of 1 inch from the back of the camera, is 1 inch long, and $1\frac{1}{2}$ inch wide (across the box) all but the two thicknesses of K and K; it is joined to the top by a hinge on its upper surface at R. K and K are the prevention flaps to the screen, they form the 1-6 of a circle, are affixed to the screen by hinges at O and O, spaces being left between their edges and those of I, equal to their thickness, to afford them play. Their thickness is half that of the screen. L is a small rail extending at the back from M to M, of the same vertical breadth, but greater horizontal width than M and M; on its inside the half of a hinge may be fixed, and be easily contrived that the back N, Fig. 2, (which fig. is reduced one half,) may work upon it, but the most convenient scheme is, to have the upper edge N rounded, and for it to work upon two brass pins in M and M, the rail forming a part of the ground-glass frame for the ultimate reception of the object. The back is $1\frac{1}{2}$ inch broad all but the thicknesses of the sides of the camera, and of sufficient length to form the required angle for the reflector placed upon it, to receive the rays from N. Let the inside of the whole be then well blacked with Indian ink, or any dull, dense, black color, (if I may be allowed the term). The back lies in Fig. 1, up against the inside of the top F, in the manner shown at Fig. 2, by the dotted lines; N being the back and S the are which it will describe in being let down to "set up" the apparatus, or in being pushed up in order to "close the scenes." The back being thus placed, we have only to let go the

top of the camera, while the front remains in the position shown at Fig. 1., and the sides will fall in, in the manner shown in this figure, until they come parallel with the bottom, there being no support inside, which support the back in the position exhibited at N, Fig. 2, previously afforded. Now that the sides are thus laid closely to the bottom, we throw the prevention flaps over the screen, while the outer edge of such screen falls down to the rail L, and to an exact level with the top; G is now thrown back so as to be parallel with, and next to F, and when thus packed a front view of the camera is Fig. 3. Once more to set it up, we take the front and turn it down at right angles with F, introducing at the same time, from the back, the hand inside the camera, to give, with the fingers, perfect perpendicularity to the double sides; the edges of these sides now fit into the groove P of G, and partly uphold the little fabric; we then pull the back part underneath F, by means of a loop of silk cord attached behind it, drawing it down until the lower edge reaches A, when the whole is permanently sustained. We now, I, throwing K and K off its upper surface, to a sufficient height to allow them, K and K, to rest upon the upper edges of M and M, in which grooves they, if wished, be cut to receive the lower edges of the prevention flaps. The hinges may all be made of strong holland, of course glued to the wood.

To use this camera obscura for photogenic or calotypic purposes, the prepared paper has merely to be laid upon the ground-glass, and covered close with I, or a flap of holland may be made to cover the open part, as it is set up by the regular method, making little or no difference in portability.

THE KALEIDOPHONE.

AN iron rod may be made to vibrate laterally or transversely, by fixing one end of it firmly, as in a vice, and leaving the other free, or by having both ends free or both fixed. When a rod, fixed at one end and free at the other, is made to vibrate, its mode of vibrating may be rendered evident to the eye; and for the purpose of doing this, Mr. Wheatstone has contrived a curious instrument, called the kaleidophone. It consists of a circular base of wood, about nine inches in diameter and one inch thick, and having four brass sockets firmly fixed into it. Into these sockets are screwed four vertical steel rods, about thirteen or fourteen inches long, one being a square rod, another a bent cylindrical one, and the other two cylindrical ones of different diameters. On the extremities of these rods are fixed small quicksilvered glass beads, either singly or in groups, so that when the instrument is placed in the light of the sun, or in that of a lamp, bright images of the sun or candle are seen reflected on each bead. If either of these rods is set vibrating, these luminous images will form continuous and returning curve lines in a state of constant variation, each different rod giving curves of different characters, as shown in the various figures.

REMARKS ON CALICO PRINTING.

BY THOMAS THOMSON, MD., FRS.

CALICO PRINTING is the art of applying one or more colors to particular parts of cloth, so as to represent leaves, flowers, &c., and the beauty depends partly on the elegance of the pattern, and partly upon the brilliancy and contrast of the colors. The process is not confined to cotton cloth, as the term calico

printing would lead us to suppose. It is applied also to linen, silk, and woollen cloth; but as the processes are in general the same, I shall satisfy myself with describing them as applied to cotton, because it is with them that I am best acquainted.

The general opinion is, that this ingenious art originated in India, and that it has been known in that country for a very long period. From a passage in Pliny, who probably composed his *Natural History* about the middle of the first century of the Christian era, it is evident that calico printing was understood and practised in Egypt in his time, but unknown in Italy.

"There exists in Egypt," says he, "a wonderful method of dyeing. The white cloth is stained in various places, not with dye-stuffs, but with substances which have the property of absorbing (*fixing*) colors. These applications are not visible upon the cloth; but, when the pieces are dipped into a hot caldron containing the dye, they are drawn out an instant after, dyed. The remarkable circumstance is, that though there be only one dye in the vat, yet different colors appear on the cloth; nor can the colors be again removed." That this description of Pliny applies to calico printing, will be evident to every person who will take the trouble to read the account of the processes which we are going to give.

The colors applied to calico in India are beautiful and fast. The variety of their patterns, and the great number of colors which they understood how to fix on different parts of the cloth, gave to their printed calicoes a richness and a value of no ordinary kind. But their processes are so tedious, and their machinery so clumsy, and they could be employed only where labor is so cheap as to be scarcely any object to the manufacturer. It is little more than a century and a half since calico printing was transferred from India to Europe, and little more than a century since it began to be understood in Great Britain. The European nations who have made the greatest progress in it, are Switzerland, France, especially in Alsace, some parts of Germany, Belgium, and Great Britain.

In Europe, the art has been in some measure created anew. By the application of machinery, and by the light thrown on the processes by the rapid improvements in chemistry, the tedious methods of the Indians have been wonderfully simplified; while the processes are remarkable for the rapidity with which they are executed, and for the beauty and variety and fastness of the colors.

I propose in this paper to give a sketch of the different processes of calico printing, such as they are at present practised by the most skillful printers in Lancashire, and in the neighbourhood of Glasgow.

Preliminary processes.—The cotton cloth, after being woven, is subjected to several preliminary processes, before it is fit for calico printing. It will be sufficient merely to allude to them. They are *singeing* and *bleaching*. The singeing is intended to remove the fibres of cotton which protrude on the surface of the cloth. This is done by passing the cloth rapidly over the surface of a red-hot iron cylinder, which burns off all the hairs, or protruding fibres of the cotton, without injuring the cloth. Of late years, an ingenious coal-gas apparatus has been substituted for the red-hot iron, both in Manchester and Glasgow.

The-bleaching of cotton consists essentially of four different processes. 1. The cloth is boiled with lime and water; it is then washed clean. 2. It is steeped

for some hours in a solution of chloride of lime, or *bleaching powder*, as it is usually called. From this steep also it is washed clean. 3. It is boiled in a solution of American potash. After the duty was taken off common salt, carbonate of soda (and consequently caustic soda) became so cheap, that it gradually took the place of pearl-ashes. 4. The cloth is now almost bleached; it requires only to be steeped in water holding in solution about four per cent. of sulphuric acid, to complete the process.

Cotton cloth at an average, takes about two days to bleach. But when there happens to be occasion for greater dispatch, it is no uncommon thing to complete the bleaching and callendering in twenty-four hours.

Printing.—There are two modes of printing, namely, *block-printing*, and *cylinder-printing*. The former has been practised from time immemorial; the latter is a modern invention, and originated, probably, after the introduction of the art of printing into Great Britain.

The *Block* is a piece of sycamore, (or, more commonly, a fir board, on which a piece of sycamore is glued) on which the pattern intended to be printed on the cloth is cut. The parts which are to make the impression are left prominent, while the rest of the block is cut away; just as is practised for wood engravings. When the pattern is too complicated, and the lines too fine to be cut in wood, they are made by means of small pieces of copper, drawn out into narrow ribbons of the requisite fineness; these are ingeniously driven into the block, and the intervals are filled up with felt. Great patience and ingenuity are displayed in making these blocks for use, and calico printers are under the necessity of keeping a number of workmen, at high wages, for that express purpose.

The inventors and drawers of the patterns constitute another class of ingenious artists, in the pay of the calico printers at high wages.

The *cylinder* is a large cylinder of copper, about a yard in length, and four or five inches in diameter, upon which the pattern to be printed on the cloth is engraved. This cylinder is made to revolve, and press against the cloth, taking up the mordants, or colors to be printed on the cloth, as it revolves. By this ingenious contrivance, two or even three different colors, are printed on the cloth at once, and the printing proceeds, without interruption, till a whole piece, or indeed, any number of pieces attached to each other are printed.

Another method of printing is almost the same as copper-plate printing. The patterns are engraved upon a flat copper plate, a yard or more square. Upon this plate, the color or mordant to be applied is spread; it is then pulled. As it passes along, an elastic steel plate, called a *doctor*, takes off all the color, except that which fills the engraving. Being pressed against the cloth in the act of pulling, it prints upon it either in mordants or colors, as may be the impression of the pattern.

Whether the printing is applied by the block, the cylinder, or the flat plate, the treatment of the goods is nearly the same. Most commonly, the printing process is employed to fix the mordants upon the cloth, which is afterwards dyed in the usual way. Those parts only retain the color which have imbibed the mordant, while the other parts of the cloth remain white. Sometimes acids, or other substances, are printed on cloth already dyed, to remove the color from certain portions of it which are to be left white, or to receive some other color.

Occasionally, substances are printed on cloth before it is dipped into the indigo vat, to prevent the blue color from becoming fixed on those parts to which they are applied. Substances possessed of these properties are called *resist pastes*.

FEATHERS OF BIRDS.

FEATHERS are of two sorts: by one the body is assisted in its motions, and by the other it is protected from cold and other external injuries. Neither the anatomy, nor the uses to which these two varieties are applied, are however so definite, but that both their fabric and uses are somewhat blended. We find every feather composed of a quill, transparent, and tubular towards the base, terminating in a solid light substance, sub-quadrangular, and covered with a prolongation of the horny tubular portion. To use the words of Mr. Griffith,—"From each side of the quill issue parallel laminæ, not flat, as they appear to the unassisted eye, but semi-tubular; having, on their outward edge, a series of bristles, set in pairs opposite one another, which clasp with the bristles of the approximate laminæ, and cause that adhesiveness observable between the several laminæ of the vane, and that readiness to re-unite after they have been forcibly separated. These bristles are not of the same form on each side of one lamina, the lower ties forming a simple and slight curve, while the upper terminates with three or four little hooks, which serve to catch the simple corresponding bristle of the next lamina." It must be evident that this infinity of minute tubes, when filled with air, must have a direct tendency to render the bird buoyant. This effect is also greatly assisted by the placing of the feathers on the body, which Mr. Mudie, in his *Natural History of Birds*, observes, "is such as always to present a smooth surface upwards and forwards, so that the animal can move in either of these directions, with very little resistance from the friction of the air. When it moves in either of them, the resistance of friction does not increase so rapidly as the rate of motion, because the pressure smooths the feathers, and causes the air to take less hold of them. This property, which arises in part from the texture of the upper surface of the feathers, but chiefly from the way in which they are formed and placed, is of equal service to birds, when they must perch, or otherwise remain at rest, so as to abide the blast, as when they fly exposed to it. When either perching or flying, a bird in the wind always faces the current, and so offers the least resistance to it, both by its form and its feathers." Thus, when the wind is high, the gunner steals up-wind on the wood-pigeon, who, in such weather, always perching in face of the blast, is insensible both to the sound and scent of his enemy. It is this arrangement of the feathers, likewise, which makes it so difficult to shoot wild-fowl, whose plumes, being both thick and numerous, are almost impenetrable unless they be struck from behind.

The feathers designed principally for clothing, however varied they be in form, and placing to those we have just described, yet exhibit an equal capability of adaptation to the purposes we have hinted at. They may be said to be set in an imbricated manner over the body, the termination of one forming the basis of two others, at the same time having their outer surface laminated, but their under surface downy. It is, however, necessary to do justice to the subject to observe, that the skin itself under

these feathers is likewise studded with fine plumose particles of a downy texture, with which the like surface of the clothing feathers unites and adheres, so as to form together a wrapper warmer than the finest lamb's wool dress. To complete this admirable tunic the *coverts* (feathers so called) are seen curving around the body, so as to perfectly deny access to either wet or cold. We cannot help requesting the reader again to look over this account, and to apply the remembrance of it to every bird he meets with; and if he be at all alive to admirable design, he will see it here; and, so observing, can never forget either the bird or the maker of that bird. It is needless for us to remark much on the tints which present themselves in the clothing feathers of birds, they being so varied as to defy critical description: we shall, however, just observe, that a metallic lustre is frequently seen over the surfaces, and most on those most exposed to the action of the elements. The feathers of birds of every kind are, indeed, to a certain degree water-proof; but those of aquatic birds are more decidedly so. An oily secretion in them, particularly, is pressed from orifices near the base of the tail, which being forced out between the mandibles is passed over the feathers by the same means; and the oil thus partially effused, is spread more evenly over the body by means of the head. This process, called *preening*, every one who has ever watched ducks by the side of a pond, must be familiar with; and the matter offers us another opportunity of pointing out how simply, but how effectively, all the wants of animals are supplied. The feathers of birds differ extremely in many respects from each other: in birds of prey they are strong and decided, yet each varies their color, though it leaves the peculiarity of figure nearly the same. There are considerable differences observable also between the feathers employed in protecting the body from cold, and hence called clothing feathers, and those by which flight is operated. These latter are much longer and stronger as well as more structurally perfect, as on them the most important actions of the life of the animal depends. By them it extends its flight in search of food; by them it pursues its prey, or retreats before a stronger foe. Most birds own three varieties of feathers: first, those which are concealed from sight, of a downy texture, and well fitted to sustain the heat of the body; second, those more external, which we have just exhibited as imbricated in their placing; those which sustain the body in its flight form the third variety, and are seen fully developed in the wings and tail. Each of these feathers is composed of a downy portion close to the insertion of the feather into the body; and of a second kind, which is webbed or laminated; third, of a pointed hollow portion, known as the quill, and which is inserted into the body. Almost the whole feathered portion, which is not immediately exposed, is white, while the exposed parts are diversified in their colorings.

The feathers which cover the body receive appellations according to their situation as follows, are exemplified in the engraving, of the body of a snipe:—A A, *auriculars*, feathers which cover the ears. B B, the *bastard wing*, covered with three or five quill-like feathers, placed at a small joint rising at the middle part of the wing. C C, the *lesser coverts of the wings*, small feathers that lie in several rows on the bones of the wings. The *under coverts* are those that line the inside of the wings. D D, the *greater coverts*, the feathers that lie imme-

diately over the quill feathers and the secondaries. E E, the *primaries*, or *primary quills*, the largest feathers of the wings; they rise from the first bone.



F F, the *secondaries*, or *secondary quills*, those that rise from the second bone. G G, the *tertiaries*. These also take their rise from the second bone at the *elbow joint*, forming a continuation of the secondaries, and seem to do the same with the scapulars which lie over them. These feathers are so long in some of the *Scolopax* and *Tringa* genera, that when the bird is flying they give it the appearance of having four wings. H H, the *scapulars*, or *scapular feathers*, take their rise from the shoulders, and cover the sides of the back. I, *coverts of the tail*. These feathers cover it on the upper side at the base. J, the *vent feathers*, those that extend from the vent, or *anus*, to the tail underneath.

THE EARL OF ROSSE'S TELESCOPE.

(From Sir J. South to the Editor of the Times.)

SIR,—The casting of the speculum of this Leviathan telescope having been safely effected, I have the pleasure of forwarding you, for insertion should you think it worthy of that honour, a brief description of the *modus operandi* adopted by the noble Earl, in the confidence that by very many of your intellectual readers it will be gratefully received both at home and abroad.

As, however, diagrams are not well suited to newspaper columns, I must endeavour to provide a substitute. Make, then, one extremity of a line $4\frac{1}{2}$ inches long, bisect a perpendicular to itself of $2\frac{1}{2}$ inches long, and the other extremity of it bisect another perpendicular to itself of 2 3-10 inches, beyond which perpendicular extend the first-named line $2\frac{1}{2}$ inches.

Call the first, the crane line; the second, the chimney line; and the third, the mould line.

On the crane line, at the distances from the chimney line of 1 2-10 inches, 2 4-10 inches, and 3 6-10 inches make dots. On the first of these dots place, centrally, a silver fourpence; on the second, a silver penny; on the third, a sixpence; on the centre of the chimney line a shilling; on each of its extreme points, a silver fourpence; on the centre of the mould line, a crown; on each of its extreme points, a sixpence; and on the uncovered extremity of the crane line, a card of 2 inches square, so that its sides shall lie either parallel with or perpendicular to the crane line. Now, supposing these several coins and card to have the same thickness as the silver fourpences, the *four ensemble* will indicate an horizontal section of the foundry; for the three fourpences will represent the crucibles in their furnaces, the shilling the chimney, the penny

the crane, the crown the bottom of the mould, the sixpences the iron pouring-baskets, and the card the floor of the annealing oven. The crucibles of cast-iron, 24 inches interior diameter, and 30 inches deep, each weighing about half a ton. They were kept *in situ* above the bars of the furnaces by cast-iron supports and subjacent brickwork. The furnaces, about $5\frac{1}{2}$ feet square, were brick; their full apertures were 4 feet diameter; their height above the gratings, 8 feet; their ashpits, 2 feet; and their several flues passed into the chimney, which was $5\frac{1}{2}$ feet square at bottom, and in height was many yards. The iron pouring-baskets were supported on wooden frames, and were supplied with pivots; one pivot of each basket having had welded on it at a convenient angle an iron lever about 3 feet long, by which the basket, with its contents, was turned on the pivot of the former without difficulty. The bottom of the mould, 6 feet 8 inches in diameter, was formed of iron-hoops, packed as closely as possible side by side, their edges up, and turned in the lathe till the upper surface had imparted to it a convexity necessary to produce the wished-for concavity in the speculum when cast. A half-crown placed centrally on the crown-piece will represent the wooden pattern for the mould; it was full 6 feet diameter, and about $5\frac{1}{2}$ inches thick. The bottom of the mould (the crown-piece) was now included in a quadrangular wood frame, and sand being rammed between it and the wooden pattern, the latter was removed with the crane, and the mould thus made, being so perfectly horizontal, was ready to receive the melted mass. The metals of which the speculum is composed are copper and tin, 126 parts of the former, $57\frac{1}{2}$ of the latter; had it been 58 of tin, the proportions would have been the atomic standard. The copper employed was fragments of copper sheathing, and about 3 tons of it were used; the tin was grain tin. The price of the former is about £100 a ton, that of the latter I do not know.

At 2 o'clock in the morning of Wednesday, the 13th of April, the furnaces were lighted, and in about ten hours the crucibles were in a state fit for receiving their respective charges.

The metal, which had been previously fused and broken up, was distributed equally amongst the crucibles, so that any accidental difference in it was probably destroyed. By 9 in the evening the furnaces were open, and the flames of nearly homogeneous yellow light which issued from them were splendid. The countenances of the bystanders looked like those of ghosts, whilst the scarlet coats of the officers present seemed a dirty yellow. Tackle from the crane was now fastened to one of the crucibles at the extremity of the chimney line, and when raised above its furnace, the revolution of the crane on its centre deposited it as quietly as possible in its corresponding iron basket; it did the same for the second crucible, and also for the third. By turning the iron baskets on their pivots, the contents of the crucibles were simultaneously poured into the mould, and some minutes elapsed before the undulatory motion of the fluid metal ceased. In about 20 minutes the quadrangular wooden frame and sand were removed; an iron ring connected with a bar passing through the even at the back aperture was clamped round the red hot speculum, the tackle of a capstan was hooked to the bar, and the speculum was hauled from the bottom of the mould over an iron railway into the annealing oven. The oven, whose interior had been kept at a dull red heat for some days, was now charged with charcoal, the arches

below with turf, and every opening of the oven built up and plastered over, and it is supposed that two months will elapse before the speculum is cool enough to be removed with safety. Not an accident or anything untoward happened during the process; and in 40 minutes from the fuse of the first crucible being moved the speculum was safely in the oven. The metal is 6 feet diameter, it is $5\frac{1}{2}$ inches thick at the edges, and 5 inches at the centre; its weight is about 3 tons. By grinding and polishing its thickness will probably be reduced 1-10th or 1-8th of an inch—it will be formed into a telescope of 50 feet focal length, and will, there is every reason to hope, be actually in use this year.

The speculum will have a reflecting surface of 4,071 square inches, whilst that of the telescope made by the immortal Herschel, under the auspices of King George III., had but 1,811. J. SOUTH.

Observatory, Kensington, April 29, 1842.

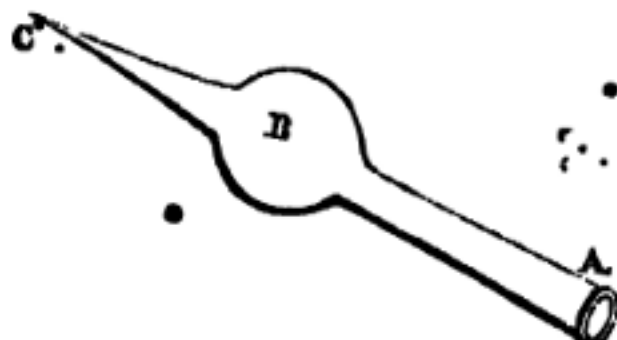
P.S.—The foundry is not many feet from Birr Castle, the residence in Ireland of the Earl of Rosse, and, with the exception of the crucibles, which were made by Messrs. Dewar, of Old-street, St. Luke's, all the apparatus employed on this interesting occasion (the steam-engine itself included) was made in workshops adjoining the Castle, under the Earl's immediate directions, by workmen trained and instructed by himself.

PRESERVING OF EGG SHELLS.

THE same desire which enters the minds of many to preserve the forms of such birds as fall in their way by taxidermy may influence them to retain the eggs also. We ourselves had a small collection of British birds' eggs, principally consisting of the warblers. It was our particular endeavour to preserve the egg entire, contents and all: but the porous nature of the shell would not shield the contents from putrefaction and decay, in spite of baking, boiling, slow-drying, spirituous immersions, &c. Even varnishing would not stand our entire friend, although it prolonged the duration of our specimens. As it appears, therefore, necessary to the lasting preservation of the shell of an egg that we abstract the contents, what is the method of accomplishing this abstraction?

To blow eggs.—It would seem unnecessary to detail the schoolboy method of "blowing" an egg-shell; but, as Mr. Waterton has condescended to treat on the subject, we need not be ashamed of so doing; and as he does it so naïve, it shall be in his own words:—"Make a moderately-sized hole at the sharp end, with a pointed instrument proportioned to the egg: thus, for a swan's egg use the point of your penknife; for a robin's take a small pin. Having made the hole at the sharp end, make one at the blunt end, and let this last hole be as small as possible. This done, apply your mouth to the blunt end, and blow the contents of the egg through the sharp end, where the hole is larger. If the yolk will not come out freely, run a pin or a wire up into the egg, and stir the yolk well about. Now get a cupful of water, and immersing the sharp end into it, apply your mouth to the blunt end, and suck up some of the water into the empty shell. Then put your finger and thumb upon the two holes, shake the water well within, and after this blow it out. The water will clear your egg of any remains of yolk or of white which might stay in after the blowing. If one sucking up of water will not suffice, make a second or a third." (*Mag. Nat. Hist.*, vol. v.

p. 516.) In the same respectable work a still better method, as it appears to us, is detailed by a correspondent, who informs us that the eggs in his collection are not punctured at the end or ends, but on one side, by a hole so small as not to blemish the egg. He observes, "The eggs in my collection are all blown with one hole at the side, and so small as to be scarcely perceptible. I use a pipe, which I had made for the purpose, and have here given you a figure of it, with the method of using it, which



may perhaps prove interesting to some of your readers who are fond of this pursuit. The method of blowing them is this: Make a small pinhole at the side of the egg, large enough to admit the point of the pipe, which is represented at C, one-sixth part of an inch; then apply your mouth to the entrance of the pipe A, and suck as hard as you can, when immediately the contents of the egg rise, and are lodged in the ball of the tube B, without proceeding higher towards the mouth. Next blow the contents down the pipe into a basin, or whatever you may have to receive it, and suck a little clean water up into the ball, and blow it into the egg; shake the egg in your hand for about a minute, and, applying the point of the tube, withdraw the water, which leaves the egg perfectly clean."

To prevent the internal membrane which lines the shell from corrupting and injuring the shell, Mr. Waterton recommends to "take a wine-glass, and fill it with a solution of corrosive sublimate in alcohol. Then immerse the sharp end of the egg-shell into it, keeping your finger and thumb, as you hold it, just clear of the solution. Apply your mouth to the little hole at the blunt end, and suck up some of the solution into the shell. You need not be fearful of getting the liquor into your mouth; for, as soon as it rises in the shell, the cold will strike your finger and thumb, and then you cease sucking. Shake the shell just as you did when the water was in it, and then blow the solution back into the glass. Your egg-shell is now beyond the reach of corruption; the membrane retains for ever its pristine whiteness; and no insect, for the time to come, will ever venture to prey upon it. If you wish your egg to appear extremely brilliant, give it a coat of mastic varnish, put on very sparingly with a camel-hair pencil. Green or blue eggs must be done with gum arabic, because the mastic varnish is apt to injure the color." It has, however, been suggested to Mr. Waterton by a friend, that the copal forms a better varnish than mastic for the purpose; and Mr. W. himself has, he thinks, improved on his own method by making one hole answer the purpose of two, particularly in the larger eggs. "Into this hole he introduces a straight wire, with a little piece of dry cotton or thread well tied round the end introduced. Then, holding the egg with the hole downwards, you see the wire, which acts as a piston, and forces a sufficient quantity of the contents of the egg out to enable you to get out the rest by sudden jerks."

EXPRESSION IN PAINTING.

THAT language which, above all others, a painter should carefully endeavour to learn, and from nature herself, is the language of the passions. Without it, the finest work must appear lifeless and inanimate. It is not enough for a painter to be able to delineate the most exquisite forms, and give them the most graceful attitudes; it is not enough to dress them out with propriety, and in the most beautiful colors; it is not enough, in fine, by the powerful magic of light and shade to make the canvass yarnish; he must likewise know how to cloathe his figures with grief, with joy, with fear, with anger; he must, in some sort, write on their faces, what they think, and what they feel; he must give them life and speech. It is, indeed, in this branch, that painting truly soars, and in a manner rises superior to herself; it is in this she makes the spectator apprehend much more than what she expresses.

Many have written, and, amongst the rest, the famous Lavater, on the changes, that according to various passions, happen in the muscles of the face, which is, as it were, a mirror of the soul. They observe for example, that in fits of anger, the face reddens, the muscles of the lips puff up, the eyes sparkle; and that, on the contrary, in fits of melancholy, the eyes grow motionless and dead, the face pale, and the lips sink in. It is necessary the painter who would be thoroughly acquainted with this principal part of his profession should study, with care, the learned and ingenious treatise of the author above mentioned; but for the young student, the short work of Le Brun, written for the pupils of the French academy of painting will be more intelligible; but it will be of infinitely more service to study them in nature itself, from whence they have been borrowed, and which exhibits them in that lively manner which neither tongue nor pen can express.

But if a painter is to have immediate recourse to nature in any thing, it is particularly in treating those very minute and almost imperceptible differences, by which, however, things very different from each other are often expressed. This is particularly the case with regard to the passions of laughing and crying, as in these, however contrary, the muscles of the face operate nearly in the same manner.

According to Leonardo da Vinci, the best masters that painters can have recourse to in this branch, are those dumb men who have found out the method of expressing their sentiments by the motion of their hands, eyes, eye-brows, and, in short, every other part of the body. This advice, no doubt, is very good, but then such gestures must be imitated with greater sobriety and moderation, least they should appear too strong and exaggerated, and instead of character the copy should degenerate into affectation and caricature.

Almost incredible things are told of the ancient painters of Greece in regard to expression, especially of Aristides, who, in a picture of his, representing a woman wounded to death at a siege, with a child crawling to her breast, makes her appear afraid, lest the child, when she was dead, should, for want of milk, suck her blood. A Medea, murdering her children, by Timomachus, was likewise much praised, as the ingenious artist contrived to express, at once, in her countenance, both the fury that hurried her on to the commission of so great a crime, and the tenderness of a mother that seemed to withhold her from it. Rembrandt attempted to

express such a double effect in the face of Mary of Medicis, still in pain from her past labour, and, at the same time, full of joy at the birth of a dauphin. And in the countenance of Sancta Polonia, painted by Tiepolo, for St. Anthony's church at Padua, is clearly read a mixture of pain from the wound given her by the executioner, and of the pleasure from the prospect of Paradise opening to her by it.

Few, to say the truth, are the examples of strong expression afforded by the Venetian, Flemish, or Lombard schools. Deprived the advantage of contemplating at leisure the works of the ancients, the purest sources of perfection in point of design, expression, and character. and having nothing but nature constantly before their eyes, they made strength of coloring, blooming complexions, and the grand effects of the *chiaro scuro* their principal study; they aimed more at charming the senses, than captivating the understanding.

The Venetians, in particular, seemed to have placed their whole glory in setting off their pieces with all that rich variety of personages and dress, which their capital was continually receiving by means of its extensive commerce, and which attracted so much the eyes of all those who visited it. It is doubtful, if, in all the pictures of Paolo Veronese, there is to be found a bold and judicious expression, or one of those attitudes, which, as Petrarch expresses it, speak without words; unless, perhaps, it be that remarkable one in his Marriage-feast at Cana of Galilee. At one end of the table, and directly opposite to the bridegroom, whose eyes are fixed upon her, there appears a woman in red, holding up to him the skirt of her garment, as much as to say, that the wine miraculously produced was exactly the color of her drapery; and, in fact, it is red wine we see in the cup and vessels. But all this while the faces and attitudes of most of the company betray not the least sign of wonder, at so extraordinary a miracle. They all, in a manner, appear intent upon nothing but eating, drinking, and making merry. Such, in general, is the style of the Venetian school. The Florentine, over which Michael Angelo presided, above all things curious of design, was most scrupulously exact in point of anatomy. On this she set her heart, and took singular pleasure in displaying it. Not only elegance of form, and nobleness of invention, but likewise strength of expression, triumphed in the Roman school, nursed as it were, amongst the works of the Greeks, and in the bosom of a city which had once been the seminary of learning and politeness. Here it was that Domenichino and Poussin, both great masters of expression, refined their ideas, as appears more particularly by the St. Jerome of the one, and the death of Germanicus, or the slaughter of the Innocents, by the other. Here it was that Raphael arose, the sovereign master of them all. There is not indeed a single picture of Raphael's, from the study of which, those who are curious in the point of expression, may not reap great benefit, particularly his Martyrdom of St. Felicitas; his Magdalen in the house of a Pharisee; his Transfiguration; his Joseph explaining to Pharaoh his dream, a piece so highly rated by Poussin. His School of Athens, in the Vatican, is to all intents and purposes, a school of expression. Among the many miracles of art with which this piece abounds, we shall single out that of the four boys attending on a Mathematician, who, stooping to the ground, his compasses in his hand, is giving them the demonstration of a theorem. One of the boys recollected within himself, keeps back, with all appearance of

profound attention to the reasoning of the master ; another, by the briskness of his attitude, discovers a greater quickness of apprehension ; while the third, who has already seized the conclusion, is endeavoring to explain it to the fourth, who standing motionless with open arms, a staring countenance, and an unspeakable air of stupidity in his looks, will never, perhaps, be able to make anything of the matter. And it is probably from this very groupe that Albano, who studied Raphael so closely, drew the following precept of his :—"That it behoves a painter to express more circumstances than one by every attitude, and so to employ his figures, that, by barely seeing what they are actually about one may be able to guess, both what they have been already doing, and are next going to do." This is a difficult precept ; but it is only by a due observance of it, the eye and the mind can be made to hang in suspense on a painted piece of canvass. It is expression, that a painter, ambitious to soar in his profession, must, above all things, labour to perfect himself in. It is in expression that dumb poetry consists, and what is called visible language.

THUNDER.

THUNDER is the noise occasioned by the explosion of a flash of lightning passing through the air : or it is that noise which is excited by a sudden explosion of electrical clouds, which are therefore called thunder-clouds. The rattling, in the noise of thunder, which makes it seem as if it passed through arches, is probably owing to the sound being excited among clouds hanging over one another, between which the agitated air passes irregularly. The explosion, if high in the air and remote from us, will do no mischief, but when near, it may ; and it has, in a thousand instances, destroyed trees, animals, &c. This proximity, or small distance, may be estimated nearly by the interval of time between seeing the flash of lightning and hearing the report of the thunder, reckoning the distance after the rate of 1142 feet to a second of time, or $3\frac{1}{2}$ seconds to the mile. Dr. Wallis observes, that commonly the difference between the two is about seven seconds, which, at the rate above-mentioned, gives the distance almost two miles : but sometimes it comes in a second or two, which argues the explosion very near to us, and even among us ; and in such cases, the Dr. assures us, he has sometimes foretold the mischiefs that happened.

Although in this country thunder may happen at any time of the year, yet the months of July and August are those in which it may almost certainly be expected. Its devastations are of very uncertain continuance ; sometimes only a few peals will be heard at any particular place, during the whole season ; at other times the storm will return, at intervals of three or four days, for a month, six weeks, or even longer ; not that we have violent thunder in this country directly vertical in any one place, so frequently in any year, but in many seasons it will be perceptible that thunder-clouds are formed in the neighbourhood, even at these short intervals. Hence it appears, that during this particular period, there must be some natural cause operating for the production of this phenomenon, which does not take place at other times. This cannot be the mere heat of the weather, for we have often a long tract of hot weather without any thunder ; and besides, though not common, thunder is sometimes heard in the

winter also. As therefore the heat of the weather is common to the whole summer, whether there is thunder or not, we must look for the causes of it in those phenomena, whatever they are, which are peculiar to the months of July, August, and the beginning of September. Now it is generally observed, that from the month of April, an east or south-east wind generally takes place, and continues with little interruption till towards the end of June. At that time, sometimes sooner and sometimes later, a westerly wind takes place ; but as the causes producing the east wind are not removed, the latter opposes the west wind with its whole force. At the place of meeting, there are naturally a most vehement pressure of the atmosphere, and friction of its parts against one another ; a calm ensues, and the vapors brought by both winds begin to collect and form dark clouds, which can have little motion either way, because they are pressed almost equally on all sides. For the most part, however, the west wind prevails, and what little motion the clouds have is towards the east : whence the common remark in this country,* that "thunder-clouds move against the wind." But this is by no means universally true ; for if the west wind happens to be excited by any temporary cause before the natural period when it should take place, the east wind will very frequently get the better of it ; and the clouds, even although thunder is produced, will move westward. Yet in either case, the motion is so slow, that the most superficial observers cannot help taking notice of a considerable resistance in the atmosphere.

Thunderbolts.—When lightning acts with extraordinary violence, and breaks or shatters anything, it is called a thunderbolt, which the vulgar, to fit it for such effects, suppose to be a hard body, and even a stone. But that we need not have recourse to a hard solid body to account for the effects commonly attributed to the thunderbolt, will be evident to any one who considers those of gunpowder, and the several chemical fulminating powders, but more especially the astonishing powers of electricity, when only collected and employed by human art, and much more when directed and exercised in the course of nature. When we consider the known effects of electrical explosions, and those produced by lightning, we shall be at no loss to account for the extraordinary operations vulgarly ascribed to thunderbolts. As stones and bricks struck by lightning are often found in a vitrified state, we may reasonably suppose, with Beccaria, that some stones in the earth, having been struck in this manner, gave occasion to the vulgar opinion of the thunderbolt.

PATENT IRON MASON.

A MACHINE under this name has been erected in one of Mr. Nelson's quarries, at Woodside, Glasgow. The stones go into the machine rough as they come from the quarrymen's pick, and come out polished ashlar on the surface, and cut parallel and square on the sides, fully prepared for the builder, and this at an expense of not more than a fourth of work done by hand. The present machine is calculated to do the work of 250 men, reckoning only six hours' work out of every ten. The machine has been constructed by Messrs. P. W. M'Onie and Co., engineers, Scotland-street, Tradeston ; the design and arrangements being the work of Mr. P. M'Onie of that firm.

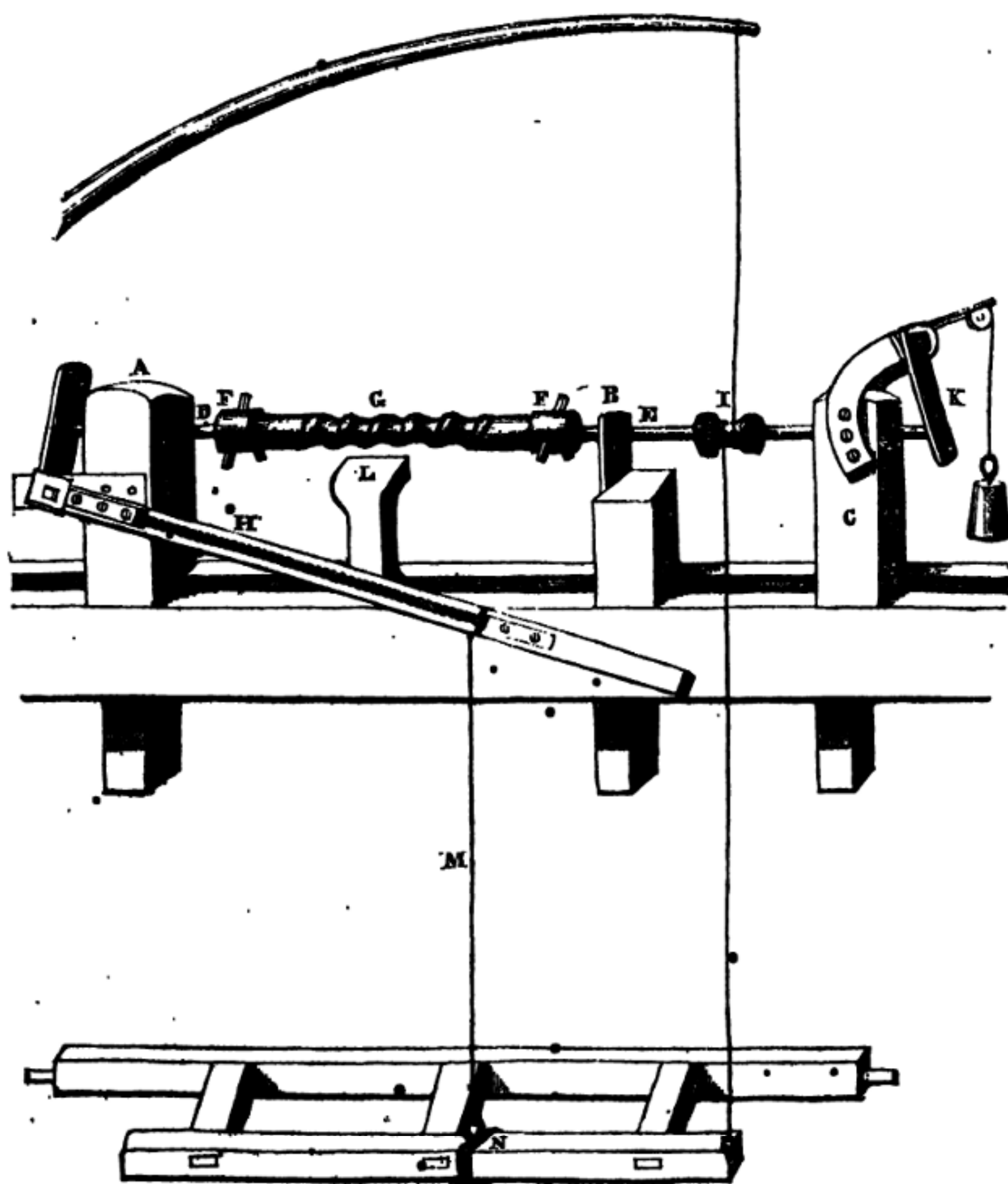
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TURNING THE ELIZABETHIAN TWIST.

ELIZABETHIAN TWIST.

(To the Editor.)

SIR.—In your last published part in your address to your correspondents, you request me to favor you with the mode of executing the Elizabethian twist, and to show my willingness to communicate any knowledge I possess, I send you the accompanying drawing, which I think is so distinct as to require but little explanation; many unsuccessful attempts convince me, that without expensive machinery it can only be done with the pole lathe, but this apparatus may be added to any lathe.

A B C are three poppits, with two rods D and E passing through them; chucks screw on to them at F F to hold the work G, and which must be turned true before being put on. H is a lever bent at a right angle so that when carried down by the treadle it forces the rod D forward, it being turned round at the same time by the line running on the pulley I. As the treadle rises the weight hanging on the bent lever K forces the rod E back again, consequently the tool on the rest at L must cut a spiral as the work traverses backwards and forwards. The lever H is wood, but has a screw of metal 18 inches in length; a nut to which the string to the treadle is attached being turned nearer or farther from the fulcrum shortens or lengthens the lever, as desired by the operator, thereby increasing or diminishing the size or length of the twist; it scarcely needs the observation that the number of turns the work takes each time of the depression of the treadle depends on the size of the pulley I; therefore the regulation of the turns of the twist and the size of the cut are governed by these two.

If a double twist is required to be turned, it is easily done by cutting another thread between each former cut, and the cut may be reversed, so as to cut either a right or left screw, by putting on the line or pulley I backwards or forwards; it makes this difference, that making the turns towards you, the cut is as the foot descends and gives a right-handed screw; making the turn from you, the cut is as the foot rises, and it gives a left-handed screw. The string M is attached to a slide at N to adjust itself to the distance of the nut at H; for this purpose a lever treadle is better than the gate, unless the centre bar is removed, with this the open twist is easily managed; but this I expect requires no explanation from me, as any experienced turner in possession of this apparatus will be at no loss how to manage it.

JAMES WILCOX.

Hornsea Cottage, 9th May, 1842.

GASEOUS EXHALATIONS FROM THE EARTH.

In several situations removed from any volcanic action, so far as is visible on the surface, natural jets of inflammable gases are seen to issue, affording decisive evidence of chemical changes that are taking place at various depths beneath. Of these, some have served the purpose of the priest to delude mankind, while part of the others have been more usefully employed.

Carburetted hydrogen gas is well known to be the "fire-damp" of the coal districts, and to issue from the coal strata; collecting in the ill-ventilated galleries of collieries, and, when sufficiently mixed with atmospheric air, exploding with great violence if approached incautiously with an unprotected flame, spreading mourning and misery among the

families of the miners. If the genius of Davy had merely produced his safety-lamp, it would alone have entitled him to the applause and thanks of mankind.

As carburetted hydrogen is so freely liberated in coal-mines, it would be expected that it should occasionally be detected on the surface, and accordingly it has been so discovered. Inflammable gas also occurs in other situations, where there is no reason to suspect the presence of coal strata. Of this, the well-known jets of gas in the limestone and serpentine district of the Pietra Mala, between Bologna and Florence, afford an example.

Captain Beaufort describes an ignited jet of inflammable gas, named the Yanar, near Delfataah, on the coast of Karamania, which perhaps once figured in some religious rites. He states that, "in the inner corner of a ruined building, the wall is undermined, so as to leave an aperture of about three feet in diameter, and shaped like the mouth of an oven: from thence the flame issues, giving out an intense heat, yet producing no smoke on the wall." Though the wall was scarcely discolored, small lumps of caked soot were found in the neck of the opening. The hill is composed of crumbly serpentine and loose blocks of limestone. A short distance down the hill there is another aperture, which from its appearance seems once to have given out a similar discharge of gas. The Yanar is supposed to be very ancient, and is possibly the jet described by Pliny.

Colonel Rooke informed Captain Beaufort, that high up on the western mountain at Samos there was an intermittent flame of the same kind; and Major Rennell stated, that a natural jet of inflammable gas, inclosed in a temple at Chittagong, in Bengal, is made use of by the priests, who also cooked with it.

The village of Fredonia, in the state of New York, is lighted by a natural discharge of gas, which is collected by means of a pipe into a gasometer. The quantity obtained is about eighty cubic feet in twelve hours. It is carburetted hydrogen, and is supposed to be derived from beds of bituminous coal. The same gas is discharged in much larger quantities in the bed of a stream about a mile from the village.

According to M. Imbert, gaseous exhalations are employed at Thsee-Lieou-Tsing, in China, to distil saline water obtained from wells in the neighbourhood. "Bamboo pipes carry the gas from the spring to the place where it is to be consumed. These tubes are terminated by a tube of pipe-clay, to prevent their being burnt. A single well (of gas) heats more than three hundred kettles. The fire thus produced is exceedingly brisk, and the caldrons are rendered useless in a few months. Other bamboos conduct the gas intended for lighting the streets, and great rooms or kitchens." These wells of inflammable gas, were, according to M. Imbert, formed for the purpose of obtaining salt water, which they in fact first gave out. The water failing, the wells were sunk to a considerable depth in order to find the water; instead, however, of finding salt water, inflammable gas suddenly rushed forth with considerable noise.

M. Klaproth notices other jets of inflammable gas in China; one, now extinguished, is stated to have burnt from the second to the thirteenth century of our era. This *Ho tsing*, or fiery well, was situated 80 li to the S.W. of Khifoung tcheou, and like those above mentioned produced salt water.

This connexion of inflammable gas with saline springs or salt is not confined to China, but has also been observed in America and in Europe. While boring for salt at Rocky Hill, in Ohio, and near Lake Erie, the borer suddenly fell, after they had pierced to a depth of 197 feet. Salt water immediately spouted out, and continued to flow for several hours; after which a considerable quantity of inflammable gas burst forth through the same aperture, and being ignited by a fire in the vicinity, consumed all within its reach.

It also appears that M. Roeders, inspector of the salt mines of Gottesgabe, at Reine, in the county of Tecklenberg, has for two or three years used an inflammable gas which issues from these mines, not only as a light, but for all the purposes of cookery. He obtains it from the pits that have been abandoned, and conveys it by pipes to his house. From one pit alone a continuous stream of this gas has issued for sixty years. It is supposed to consist of carburetted hydrogen and olefiant gas.

Inflammable gases are also found to proceed from ground charged with petroleum and naphtha. The inhabitants of Baku, a port on the Caspian Sea, are supplied with no other fuel than that derived from the petroleum and naphtha with which the earth in the neighbourhood is strongly impregnated. About ten miles to N. E. of this town there are many old temples of Guebres, in each of which there is a jet of inflammable gas, rising from apertures in the earth. The flame is pale and clear, and smells strongly of sulphur. Another and a larger jet issues from the side of a hill. The ground is generally flat, and slopes to the sea. If in the circumference of two miles, holes be made in the earth, gas immediately issues, and in flames when a torch is applied. The inhabitants place hollow canes into the ground, to convey the gas upwards, when it is employed for the purposes of cookery as well as for a light. M. Lenz, describing an eruption of mud and flame near the village of Iokmali, fourteen wersts to the west of Baku, would seem to attribute the gaseous exhalations of this district to a volcanic origin, but the facts adduced will scarcely admit of this interpretation. He notices this eruption as having taken place on November 27th, 1827. A column of flame burst out, where no flame had been previously seen, and rose for three hours to a considerable height, then lowered itself to the height of three feet, and burnt for twenty-four hours. After this the mud rushed forth and covered the country over an area of 200 toises by 150, to the depth of two or three feet.

Carbonic acid gas is evolved abundantly in coal-pits and volcanic regions. Its occurrence in the Grotto del Cane, of which such overcharged descriptions have been given, is well known. MM. Bischof and Nüggerath notice a pit, on the side of the lake of Laach, in which they found dead birds, squirrels, bats, frogs, toads and insects, killed by the evolution of carbonic acid gas. M. Bischof estimates that the exhalations of carbonic acid gas, in the vicinity of the lake of Laach, amount to 600,000 pounds.

In the Brohlthal on the Rhine, an old volcanic country, there is a considerable evolution of carbonic acid gas, which is employed by M. Bischof in the manufacture of chemical preparations on the large scale. Six hundred pounds of this gas are calculated to be discharged from only one of the jets in twenty-four hours, being at the rate of 219,000 pounds in the year.

Carbonic acid gas is so abundantly evolved in a district of mineral springs in Armenia, near Forte Diadina, on the Euphrates, that it produces a noise while issuing through the cracks in the limestones of the country, killing the birds which come within its influence.

The Guevo Upas, or Valley of Poison, in Java, would appear to be a cavity filled to a certain height with carbonic acid gas. Mr. Loudon describes it as about half a mile in circumference, and of an oval form. The depth is from thirty to thirty-five feet, the bottom being flat, without vegetation, and covered with skeletons of men and of various animals, such as tigers, hogs, deer, &c., which have perished by their entrance into the gas. The destructive gas did not rise, so as to be dangerous, above eighteen feet from the bottom.

A very copious discharge of carbonic acid gas occurs on the Kyll, nearly opposite Birresborn. The gas rises through fissures of the rock, and traverses a pool of rain water, resting on it, with such violence that the noise is stated to be heard at the distance of 400 yards. Birds are killed when they approach too close, and persons wishing to drink are driven away by the gas, a stratum of which covers the surrounding turf.

In many situations gaseous vapors come to the surface mixed with water or petroleum, with sufficient force to produce "salses" or mud volcanos. Dr. Daubeny considers those of Maculaba in Sicily as independent of volcanic action, but due to the combustion of the sulphur existing among the rocks. Mud eruptions from the discharge of gaseous vapors and water are known in many other places.

MANILLA HEMP.

This article is obtained from a species of plantain, the "*Musa Trogloditarum textoria*," and is probably a variety of the *Musa Trogloditarum errans*; the lower edge almost without incision, stamens five, without rudiments of sex, fruit with three ribs and many perfect seeds. It is one of the most useful plants and is cultivated with care in the province of Camarines, and in other parts. At first sight it is very small, seldom exceeding two inches in length. The use made of this plantain is immense; of it are made ropes, cables, and woven cloth of extreme fineness.

In preparing the hemp they cut the tree near the ground at the time it is about to produce fruit, and also cut off the upper extremity or head, removing the leaves. They tear off one by one the layers, and with a knife remove the skin from the inner surface. The layer or roll being now stripped of its inner skin, is torn into strips of about two fingers' breadth. These strips are placed, one at a time, on a table or piece of wood, below the edge of a knife, which is pressed down upon the table by a long bamboo fastened in the earth.

The strip of the layer being placed beneath the knife, the outer skin or surface uppermost, they pull it with force by one end. The knife removes the skin, and the pressure on the table enables the table to remove the fleshy substance. It is usually pulled but once; that is to say, when the strip is placed under the knife; about two feet remain on the side of the operator, which he grasps to pull it through; this done, he turns it, placing the other end under the knife, and grasping the end which now shows only the fibre, he by the second pull finishes this part of the process. The handful of threads or fibres is then placed with others on a branch of a tree, or

peg, in the side of his hut, till a quantity is accumulated. The process by the knife is so tedious, that three men will make only 13½ lbs. in an ordinary day's work.

The fibres thus prepared are separated into various qualities by the women. They weave them with great dexterity, even in the dust. If the hemp is to be used for making cloth, it is first wound into a ball about the size of a child's head, which is then placed in the wooden mortar used for husking rice, and is pounded for some time with the wooden pestle. This operation renders it very flexible, and less liable to break. This being done, the fibres are tied together, which is usually done by women and girls. The weaving process is the same as for cotton fabrics; but if the hemp (*i. e.* plantain) fibres are very fine, they place the women who weave it under a cover or a shade, because the wind easily breaks the threads. The cloth being woven, is placed for a day and night in water, with a little lime made from sea-shells. It is afterwards washed and stretched out. Although the hemp is strong, yet it is inferior to linen thread, and to thread of European hemp, both in respect of strength and in the gloss and touch. Hemp (*i. e.* of the plantain) is produced of good quality in the province of Batangas, and in other parts, but not equal in quality to that of Camarines province; and this latter again appears inferior to that of Panai and Marinduque Islands. On this point, however, opinions differ.

The hemp is easily dyed of blue and pink colors. To dye it blue, they still employ, as in olden times, the leaves of a shrub or twining plant, which, in Camarines, is named *payanguit* and *aringuit*, the *Marsdenia akir*. An intelligent description of this twining plant was made to the Politico-Economical Society of Manilla, by that curious and diligent observer, Padre Jose de Mata, of the order of San Francisco; and it is he, who, in these our days, has brought this plant to the notice of the European dwellers in the Philippines. The leaves of this plant give blue color in abundance.

To dye the hemp pink, in Camarines province they boil the bark of the root of the *Morinda* with a little lime or alum, till the desired color is obtained, and with this they proceed to dye. But it is better to dye in the same manner as used for cotton thread, which is with a solution of wood-ashes and oil of *Sesamum*.

The hemp of commerce is brought to Manilla chiefly in native rigged boats of fifty to one hundred tons burthen, termed *pontines*, from Camarines and Albay provinces, and from Zebu Island. The price paid to the actual producer in the interior of the country is not known; but considering that it is a bulky article, the cost of transportation must be heavy, as it is brought to the ports of shipment for Manilla, chiefly on horseback, through a country where there are few roads, and must also be collected from house to house; the price, therefore, that can be afforded to the native labourer must be very trifling. At the ports of shipment, when roughly made up into bales, it costs generally about —per picul of 140 English pounds, on board the *pontines*. The general price at which they sell it in Manilla to the exporters is from 3.75 to 4.25 dollars per picul. It is delivered from the *pontine*, at some of the various hemp screws, where it is opened out, and again made up into well-shaped bales, each weighing two piculs, or 280 English pounds, net, and measuring about ten and a half

cubic feet. In this state it is ready for transmission on board ship, and is generally known in commerce. The expenses of screwing, shipping, and two per cent. export duty, amount to about half a dollar per picul of 140 lbs.

HOW TO MAKE BALLOONS.

WITH regard to the construction of air-balloons, whether small for mere amusement, or large for philosophical purposes, it is necessary that they should weigh as little as possible. On this account the shape of the machine becomes an object of great consideration. The form which has been found best calculated to answer the purpose, is that of a sphere, or globe.

The next thing to be determined is the stuff proper for the envelope. For experiments, both the inflammable-air and fire balloons may be made of paper; the former of that kind called *thin post*, or *bank post*, varnished over with linseed oil; the latter of what is called *tissue* or *silver paper*, without varnish. The inflammable-air balloons may also be made of gold-beaters' skin, cut into strips of the proper form, and glued together by gum arabic. But the neatest contrivance for small balloons which has yet been offered, is a small thing resembling a bladder, made from the maw of a turkey, and sold by the philosophical instrument makers: this, when inflated with inflammable air, rises in the atmosphere: balloons of this last kind cost from 2s. to 8s. according to the size.

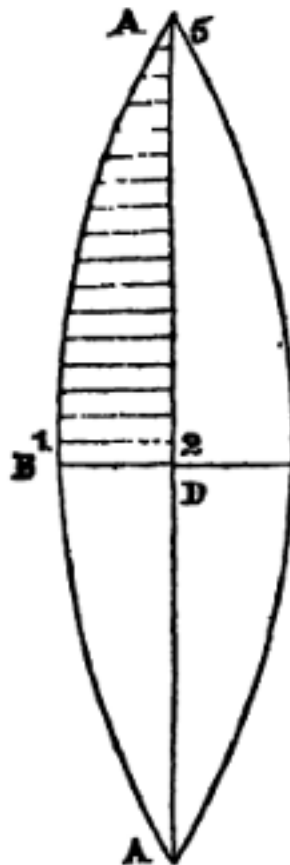
For large balloons, the silk stuff called *lutestring* is used as the envelope of hydrogen gas, and linen cloth lined with paper for rarefied air. We are informed that, lately, Mr. Graham has used for hydrogen-gas balloons a species of gauze, which is equally light with silk, and less expensive. The stuff for both kinds requires some previous preparation. The best mode of preparing the cloth for a machine upon Montgolfier's principle is first to soak it in a solution of sal-ammoniac and size, using one pound of each to every gallon of water; and when the cloth is dry, to paint it over with some earthy color, and strong size or glue. It may also be varnished over when perfectly dry, with some stiff, oily varnish, or simple drying linseed oil, which would dry before it penetrated quite through the cloth.

The best composition for varnishing hydrogen gas balloons is the following—Render linseed oil drying, by boiling in a pint of it, two ounces of sugar of lead and three ounces of litharge, till they are dissolved, which may be in half an hour. Then put a pound of birdlime and half a pint of the drying oil into an iron or copper vessel, whose capacity should equal about a gallon, and let it boil very gently over a slow charcoal fire, till the birdlime ceases to crackle, which will be in about half or three-quarters of an hour: then pour upon it two pints and a half more of the drying oil, and let it boil about an hour longer, stirring it frequently with an iron or wooden spatula. As the varnish, whilst boiling, and especially when nearly ready, swells very much, care should be taken to remove, in these cases, the pot from the fire, and to replace it when the varnish subsides; otherwise it will boil over. Whilst the stuff is boiling, the operator should occasionally examine whether it has boiled enough, which may be known by observing whether, when rubbed between two knives, which are then to be separated from each other, the varnish forms threads between them, as it must then be removed from the fire: when nearly cool,

add about an equal quantity of oil of turpentine. In using the varnish, the stuff must be stretched, and the varnish applied lukewarm; in twenty-four hours it will be dry.

The best method of cutting the pieces that are to form a balloon, is to describe a pattern of wood, and then to cut the silk upon it. As the edges of such a pattern are not perfect segments of circles, they cannot be described by a pair of compasses; but the best method of forming them is as follows:—1. Draw on a flat surface two right lines, A A and B C, perpendicular to each other. 2. Find the circumference answering to the given diameter of the balloon, in feet and decimals of a foot, and make A D and D A each equal to a quarter of the circumference, so that the whole length A A of the pattern may be equal to half the circumference. 3. Divide A D into 18 equal parts; and to the parts of division apply the lines 1—2, &c., parallel to each other, and perpendicular to A D. 4. Divide the whole circumference by twice the given number of pieces, and make B D and D C each equal to the quotient of this division, so that B C is equal to the whole breadth of one of these pieces. 5. Multiply the length B D by the decimals annexed below, to the 17 lines which divide the line B D into 18 spaces; and the several products will express the length of the said lines.

33—34	0.08716
31—32	0.17365
29—30	0.25882
27—28	0.34202
25—26	0.42262
23—24	0.50000
21—22	0.57358
19—20	0.64270
17—18	0.70711
15—16	0.76604
13—14	0.86915
11—12	0.86603
9—10	0.90631
7—8	0.93969
5—6	0.96593
3—4	0.96481
1—2	0.99619
D C	1.00000



Thus, if the balloon is to be twelve feet in circumference, and is to be formed of twenty-four pieces or gores of silk, then B C will measure 6 inches, and B D 3 inches: after which we find that

$$\begin{array}{r} 0.99619 \\ \times 3 \\ \hline 2.98857 \end{array}$$

will be the length of 1—2: and

$$\begin{array}{r} 0.08716 \\ \times 3 \\ \hline 0.26148 \end{array}$$

0.26148 will be the length of 33—34 (the shortest line). The lines between these are to be calculated in the same way.—Lastly, having found the lengths of all these lines, draw by hand a curve line passing through all the extremities of the said lines, and you will thus produce one quarter of the pattern, represented by the curve line A B. The other quarters may be easily described, by means of a piece of

paper cut according to that already found. In cutting the pieces of silk from this pattern, care should be taken to leave them about three-quarters of an inch all round larger than the pattern, which space will be taken up by the seams when the pieces are sewed together.

To the upper part of the balloon is attached a valve opening inwards, with a string fixed to it long enough to reach to the car below. The use of this is to allow the gas to escape when the aeronauts are desirous of descending. When the string is not pulled the valve is kept shut by the elasticity of the gas. There should be a contrivance to keep the valve from being opened too far.

MENAI SUSPENSION BRIDGE.

An account of the progress of this stupendous work of art, exhibiting, as it does, the application of malleable iron on the largest scale, must be acceptable no less as a record of the triumph of science, than as a narrative of general interest. It is derived from the account by Dr. Pringle, who resided in the vicinity of the bridge, and attended regularly to the progress of the structure.

The first operations of the workmen took place in May, 1819, and consisted in blasting the rock called Ynys-y-nuch, which was then only accessible at low water, in order to form a solid foundation for the north main pier on the Anglesea side. For this purpose, in a few months afterwards, the intermediate space between the Anglesea shore and the rock was filled up with a temporary causeway of stone-work, wide enough to admit of a rail-road for sledges drawn by horses, and which being considerably elevated above high water mark, afforded the workmen an opportunity of passing and repassing to their various occupations at all times without hinderance. Previous, however, to the shutting up the navigation (as authorised by an act of parliament), for the purpose of carrying the suspension chains over without interruption by vessels passing through the straits, this temporary causeway was taken down, and the channel made considerably deeper and wider than before, by which means coasting vessels of a moderate tonnage were now, for the first time, enabled to pass through this narrow strait with perfect ease and safety. The impetus of the tide in this part of the strait is at the rate of five miles per hour.

The temporary causeway being completed, and the rock rendered even by the aid of masonry, the first stone of this astonishing work was laid privately by Mr. W. A. Provis, the resident engineer, on Tuesday, the 10th of August, 1819. In the autumn of the same year the preparations for the foundation of the south main pier on the Caernarvon side were begun.

This pier, from the depth of its foundation (seven feet), exceeds considerably the one on the opposite shore both in masonry and workmanship; a distinction which is very apparent at low water. The four arches on the Anglesea side, which for magnitude and grandeur can hardly be surpassed, were begun early in the spring of 1820, and completed in the autumn of 1824. This work is built of a grey marble, procured upon the sea shore N. E. of the island of Anglesea, on the property of Lord Bulkeley, for which his lordship was paid sixpence per ton by government.

After the completion of the seven large arches, the smaller ones intended for the road-way were con-

structed, each being fifteen feet to the spring of the arch, and nine feet in width, through which carriages, &c. were to pass. When the arches were turned, the suspension piers were further elevated, tapering gradually in a pyramidal form, to the height of 53 feet from the level of the road by solid masonry; each stone being bound by iron dowels from the top to the bottom of these piers, to prevent their being separated or bulged by the immense pressure of the suspension chain.

The next process was the iron department. On the extreme height of the suspension piers are placed the cast iron blocks or saddles (with wrought iron roller and brass bushes) for the purpose of regulating the contraction of the iron, by moving themselves either way as may be required, according to the temperature of the atmosphere, without causing the least derangement in any part of the work. These rollers are most ingeniously constructed, and form a desideratum in this line of bridge building.

In order to form a permanent seat, grasp, or hold for the iron frames, to which the lower or extreme ends of the suspension chains were to be made fast, three oblique cavities or openings, of a circular form, and about six feet diameter, were made by blasting in the natural body of the rock on the Anglesea side, leaving a considerable width of rock for the suspension chains. These excavations were carried down like an inclined plane to the depth of twenty yards.

This being accomplished, a connecting avenue or chamber was formed horizontally at the bottom of the cavities, sufficiently capacious for the workmen to fix the iron frames, composed principally of flat cast iron plates, which were afterwards ingrafted as it were into the natural rock, so as to bid defiance to any stress that might bear upon them, and to be immovable unless the solid rock itself could give way. A similar mode of proceeding was adopted on the Caernarvonshire side.

The suspension chains, which are made exclusively of wrought iron, being firmly secured and made fast to the iron frames just mentioned, the chain bars, each ten feet in length, were then laid down by placing five together—equivalent to one breadth of the chain, and carried on by consecutive lengths, joined by flat iron plates and bolts, to the apex of the suspension piers, supported underneath all the way up by a temporary frame-work of strong timber, the upper end of the chains resting on the cast iron saddles which had been placed there to receive them. A similar course was pursued with the ascending portion of the chain on the Caernarvonshire side; only that from a difference in the ground this required to be lengthened by additional chain bars from the apex of the pier perpendicularly nearly to high water mark. • • •

On the 26th of April, 1825, the first chain of the curved part of this stupendous work was thrown over the straits of Menai; the day was highly propitious, and the joy of the interested spectators as might be expected, very great. A larger concourse of persons than it is believed ever assembled in the situation before, crowded the Anglesea and Caernarvonshire shores, to witness a scene such as their ancestors never conceived. Mr. Telford attended to see this part of his grand scheme carried into effect. Soon after noon, it being half-flood tide, the raft, which was 450 feet long and 6 feet wide, stationed on the Caernarvon side, and which supported the part of the chain intended to be drawn over, began to move slowly from its moorings, towed by four boats to the centre of the river between the two

grand piers: when the raft was brought to its ultimate situation (which was in about twenty minutes), it was made fast to several buoys anchored in the channel for that purpose. The part of the chain ending from the apex of the suspension pier was then made fast by a bolt to the part of the chain lying on the raft. The next operation was fastening the other extremity of the chain, still lying on the raft, to two large blocks for the purpose of hoisting it up to its intended station—the apex of the suspension pier on the Anglesea side: the tension of the chain at this time was forty tons. When the blocks were made secure to the chain, two capstans, and also two preventive capstans commenced working; each capstan being propelled by thirty-two men, two fifers regulating their steps, and enlivening the scene by playing an appropriate tune. The chain rose majestically, and before five o'clock the final bolt was fixed amidst the hearty acclamations of the thousands of spectators who thronged the ground on both sides. Not the least accident, delay, or failure of any kind occurred throughout the day.

On the completion of the chain, three of the workmen had the temerity to pass along its upper surface, which forms a curvature of 590 feet; the versed sine of the arch is forty-three feet. On the termination of the day's proceeding, the workmen, 150 in number, were regaled, by order of the right honourable the parliamentary commissioners of the Holyhead road improvements, with a quart of *crw da* each.

The other fifteen chains were carried over in as many days; the entire line of suspension being completed by the insertion of the last bolt on the 6th of July. The chains being all adjusted, and placed equidistant to each other, the vertical rods were fastened to them; the lower ends being firmly bolted to the iron sleepers, on transverse rods bars, each vertical rod and sleeper being placed longitudinally, five feet apart. There are 111 of these sleepers, to each of which are attached transversely four vertical rods, making the whole number of rods between the suspension pier 444.

The next process was the formation of the roadways: these consist of two carriage lines, each twelve feet broad; and a foot path, four feet wide, in the centre between them, inclosed all along by an iron railing to preserve passengers from accident.

On the 30th of January, 1826, this singular structure, which during its progress had excited so much attention, as well from its novelty as its magnitude, was opened to the public by the London and Holyhead mail coach passing over with the bags for Dublin. About 5000 persons who were present were then allowed freely to parade the platform for several hours. On the 1st of February, the first three-masted vessel passed under the bridge, with all her spars up: her topmasts were nearly as high as those of a frigate, yet they cleared twelve feet and a half below the centre of the road-way.

ELECTRIC PROPERTIES OF SILK.

THE discovery that silk is an electric, or a non-conductor of electricity, originated in one of those fortunate accidents to which science has been indebted for many of her most valuable discoveries. This fact it was which first led to the beautiful disclosure of the distinction between electrics and non-electrics.

In 1729, while the knowledge of electrical phenomena was yet in its infancy, Mr. Grey, after performing many interesting experiments, succeeded in

conducting the electric fluid, excited by friction in a glass tube, through a perpendicular distance of many feet, by causing one end of a piece of iron wire or packthread to communicate with the glass tube, and the other end with an ivory ball. Pleased with his success, he became desirous of conducting the fluid horizontally; but this experiment failed at the time, through the mode of his attempting it, which was by carrying his line over a packthread cord, suspended for the purpose across the room. Through this material the electric stream escaped, and the ivory ball was, in consequence, no longer found to be excited.

Mr. Grey having communicated to a friend the ill success which had attended this attempt, was advised to suspend the conducting line by *silk* instead of *packthread*; there being no other reason for this advice than the greater fineness of the former. Acting upon this suggestion, their first experiment was made in a large matted gallery; a line, the middle part of which was of silk and the two extremities of packthread, was fastened across the gallery; the conducting line with the ivory ball at the end was passed over the silken portion, and hung nine feet below this horizontal line of suspension. The conducting line was eighty feet and a half in length, one end being fastened by a loop to the electric tube; upon rubbing this, the experimenters had the gratification of finding that the ivory ball attracted and repelled light substances in the same manner as the tube itself would have done. They next contrived to return the line, so that the whole length amounted to 147 feet, and in this case likewise the experiment answered tolerably well; but suspecting that the attraction of the electric fluid would be stronger if the line were not doubled, they carried one straight forward through a distance of 124 feet. In this anticipation they were not deceived, the attraction under these circumstances being stronger than when the line was doubled. Proceeding thence to add more and still more to their conducting line, until at length the slender silk thread broke from the weight imposed, they sought to substitute for this fragile cord a small wire, first of iron and then of brass. The unsuccessful result, however, soon brought them to the conviction, that the refusal of the silk to conduct the electric fluid was not owing to its fineness, but proceeded from some inherent property possessed by the material. The metallic wires were smaller even than their silken thread had been, and yet effectually carried off the electricity: thicker silken cords were therefore adopted, and, as before, the electric fluid was conveyed to a great horizontal distance, without suffering any diminution of its virtue.

This knowledge of the non-conducting power of silk was quickly followed by the discovery of the same quality in many other substances, and thus accidentally was laid the foundation of many of the subsequent improvements in the science of electricity.

No particular attention was paid to the electric qualities of silk, nor were any experiments made on it as an electric, until the year 1759. Mr. Symmer's notice was then attracted to the subject by the following whimsical circumstance, which led him to the performance of many curious experiments. The results of these he communicated to the Royal Society, by whom his paper was inserted in the fifty-first volume of their "Transactions."

Mr. Symmer was in the habit of wearing at the same time two pairs of silk stocking; the under pair white, and the upper black. If these were

pulled off together, no sign of electricity appeared; but if the black stockings were pulled off from the white, a snapping or crackling noise was heard; and when this happened in the dark, sparks were plainly perceived between them. Thus incited, their philosophic wearer proceeded to make some further observations on the subject. He found, that by merely drawing his hand several times backwards and forwards over his leg while the stockings were upon it, he produced, in great perfection, the following appearances.

On the stockings being taken off separately and held within a certain distance of each other, both appeared to be highly excited, the white stocking vitreously, the black one resinously. While kept at a small distance from each other, they were so inflated that they exhibited the entire shape of his leg; and if brought somewhat nearer, would immediately rush together. The inflation gradually subsided as they thus approached, and their attraction of extraneous objects diminished as their mutual attraction increased, so that when they actually met, they became flat and adhered together like so many folds of silk. On being again separated, their electric powers did not seem to be at all impaired, and they continued for a considerable time to afford a repetition of these appearances. If the two white stockings were held in one hand, and the black ones in the other, they were thrown into a strange agitation, owing to the attraction exercised between those of different colors, and the repulsion between those of the same color. This conflicting of attractions and repulsions caused the stockings to rush to each other from greater distances than they would otherwise have done, and "afforded a very curious spectacle."

If the stockings were allowed to meet, they adhered together with considerable force. They required at one time a weight of twelve ounces for their separation; and on another occasion, when they were more highly electrified, they sustained, in a direction parallel to their surface, as much as seventeen ounces, which was twenty times the weight of the stockings. If one were placed within the other, it required a weight equal to twenty ounces to separate them, although half this sufficed for the purpose if the stockings were applied to each other externally.

The black stockings being newly dyed, and the white ones first washed and then bleached by exposure to the vapor of sulphur, their mutual attraction was seen to be much increased. Under these circumstances, if one was placed within the other with their rough sides together, it required a force of three pounds three ounces to separate them.

With stockings of more substantial make, the cohesion was found to be still stronger. A white stocking of this description was placed within a black one of similar quality; first with the right side of one contiguous to the wrong side of the other, and afterwards with the two rough surfaces touching each other: in the first case they raised nearly nine pounds, and in the second, the still more surprising weight of fifteen pounds, without separating their surfaces. The tufts and ends of silk which are generally found on the inside of stockings considerably assisted towards the result of these experiments, which were not nearly so striking after these tufts were removed.

In the course of his experiments, Mr. Symmer also discovered that black and white silk, when highly electrified, not only cohere to each other, but

will also adhere to any broad and to any polished surfaces, even although these bodies should not be themselves electrified. Having undesignedly thrown a stocking out of his hand, it struck against the side of the apartment, and adhered to the paper-hangings. He repeated the experiment, and found that the stocking would continue its adhesion for nearly an hour. Placing a black and a white stocking against the wall in this manner, he applied the two others to them, which had previously been highly electrified; and putting the white to the black and the black to the white, he carried them off from the wall, each of them hanging to that which had drawn it from its situation. When the stockings were applied to the smooth surface of a looking-glass, they adhered even more tenaciously.

Similar experiments, combining a greater variety of circumstances, were afterwards made with white and black ribands by Mr. Cigna of Turin, an account of which was published in the Memoirs of the Academy of that city for the year 1765.

Having dried before the fire two white silk ribands, and extended them upon a smooth plane, he then several times drew over them the sharp edge of an ivory rule, and found that both ribands had by this friction acquired sufficient electricity to adhere to the plane, although they gave no indications of being in this state of excitement during their continuance upon it. It was not at all material to the success of the experiment, whether this plane was itself an electric or non-electric substance. When taken up separately, the ribands both appeared to be resinously electrified, and repelled each other: on dividing them, electric sparks were perceived between them, but on being again forced together or placed on the plane, no sparks were given off until they had been again excited by friction. When by means of the ivory rule they had thus acquired the resinous electricity, if, instead of being replaced on the smooth body whereon they had been rubbed, the ribands were applied to a rough conducting surface, they would on their subsequent separation show contrary states of electricity, which would again disappear on their being brought together. If after having been made by friction to repel each other, they were forced together upon such a rough surface, they would in a few minutes be mutually attracted, the under one being vitreously and the upper riband resinously electrified.

If the two ribands were subjected to friction upon a rough surface, they uniformly acquired contrary states of electricity, the upper being resinously and the lower one vitreously affected, in whatever manner they might be taken off. The same change was instantaneously produced by the use of any pointed conductor. If, for instance, the two ribands having been made to repel each other, the point of a needle were drawn along the whole length of one, it would cause both instantly to rush together. The same means employed to effect a change of electricity in a riband already electrified, would communicate electricity to the other which had not yet received the excitement. An unelectrified riband would become electrified if placed upon a rough surface and an electrified riband were put upon it, or if the one were held parallel to the other and a pointed conductor were presented.

Upon a smooth surface, Mr. Cigna placed a riband that was not quite dry, and applied over it another that had been well dried before the fire, when, after

applying to them the usual friction with the ivory rule, he found that, in whatever manner they were removed from the surface, the upper one was always resinously and the lower one vitreously electrified. Exactly the same results were produced if the ribands employed were black instead of white. If any kind of skin, or if a piece of smooth glass, were used in place of the ivory rule, the effect was exactly the same; but if a roll of sulphur were substituted, the ribands then uniformly acquired the vitreous electric state: when rubbed with paper, either gilt or not gilt, the effects were uncertain. If the ribands were placed between folds of paper on a plane surface, and friction were then applied to them, both ribands acquired the resinous electricity. When one riband was black, and the other white, the black generally acquired the resinous and the white the vitreous state, whatever might have been their relative position, or the manner of applying friction.

Mr. Cigna likewise observed, that when the texture of the upper piece of silk was loose, yielding, or retiform, like that of a stocking, so that its elasticity caused it to move up and down with the corresponding movements of the rubber against the surface of the lower riband; and if the rubber employed were of such a nature as to communicate but little electricity to glass, the excitement did not depend upon the action of the rubber, but upon the body whereon it was placed. In such a case, the black silk was always resinously and the white vitreously affected. But if the riband was of a close unyielding texture, and the nature of the rubber such as would communicate a high degree of electricity to glass, then the excitement of the upper piece depended altogether upon the rubber. Thus, if a white silk stocking were rubbed with gilt paper upon glass, it became resinously and the glass vitreously electrified; but if the piece of silk thus placed upon the plate of glass were of a firmer texture, it was electrified vitreously and the glass resinously, when sulphur was employed as the rubber; and most generally the same effect followed the use of gilt paper.

If an electrified riband were brought near to an insulated plate of lead, it would be very feebly attracted. If then a finger were brought nigh to the lead, a spark might be observed to pass, and the riband was powerfully attracted, but showed no farther sign of electric excitement after coming, in contact with the metal. On their separation, however, both substances appeared again electrified, and a spark passed between the plate and the finger.

Numerous other experiments, equally simple and easy of accomplishment, may be made on the electric properties of silk, which are, no doubt, familiar to such persons as have at all attended to the science of electricity. Silk, more remarkably than any other substance, exhibits a strong and permanent attractive and repulsive electric power. Its property of exciting electricity by friction is of extensive application, causing it to hold an important place among the substances employed to exhibit the wonders of this science: silk always forms part of the apparatus of electrifying machines.

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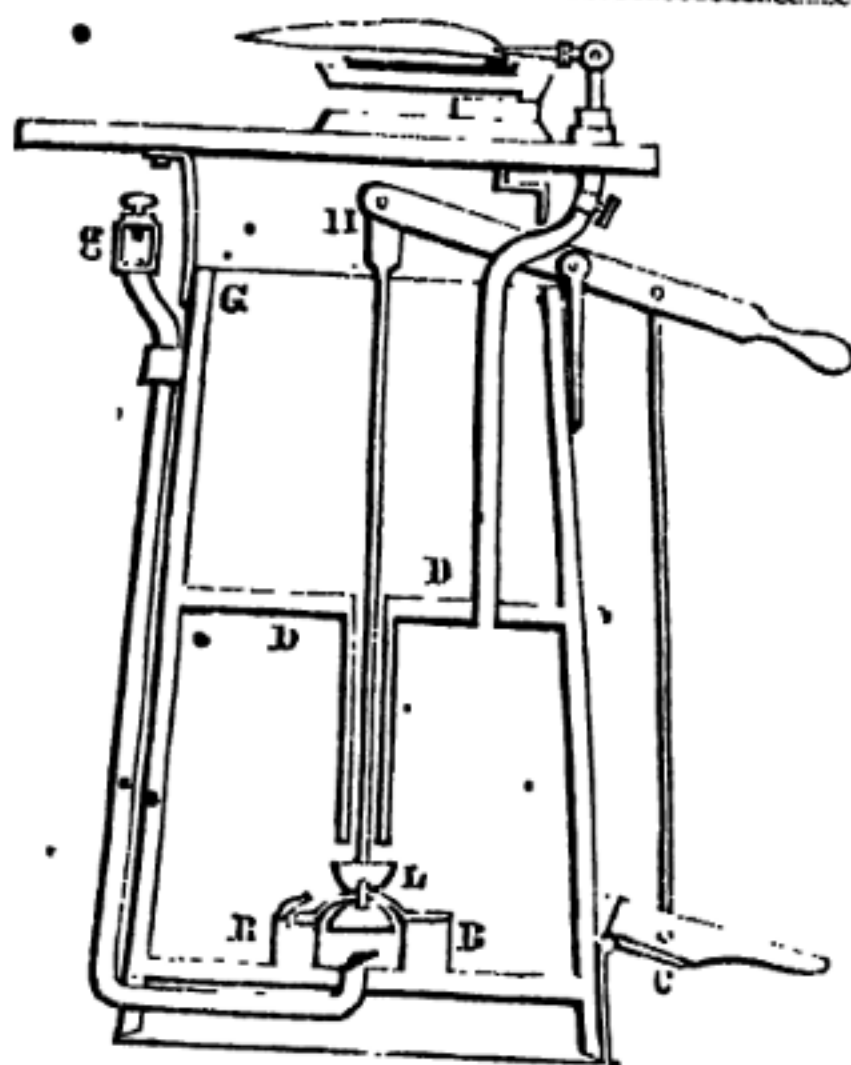
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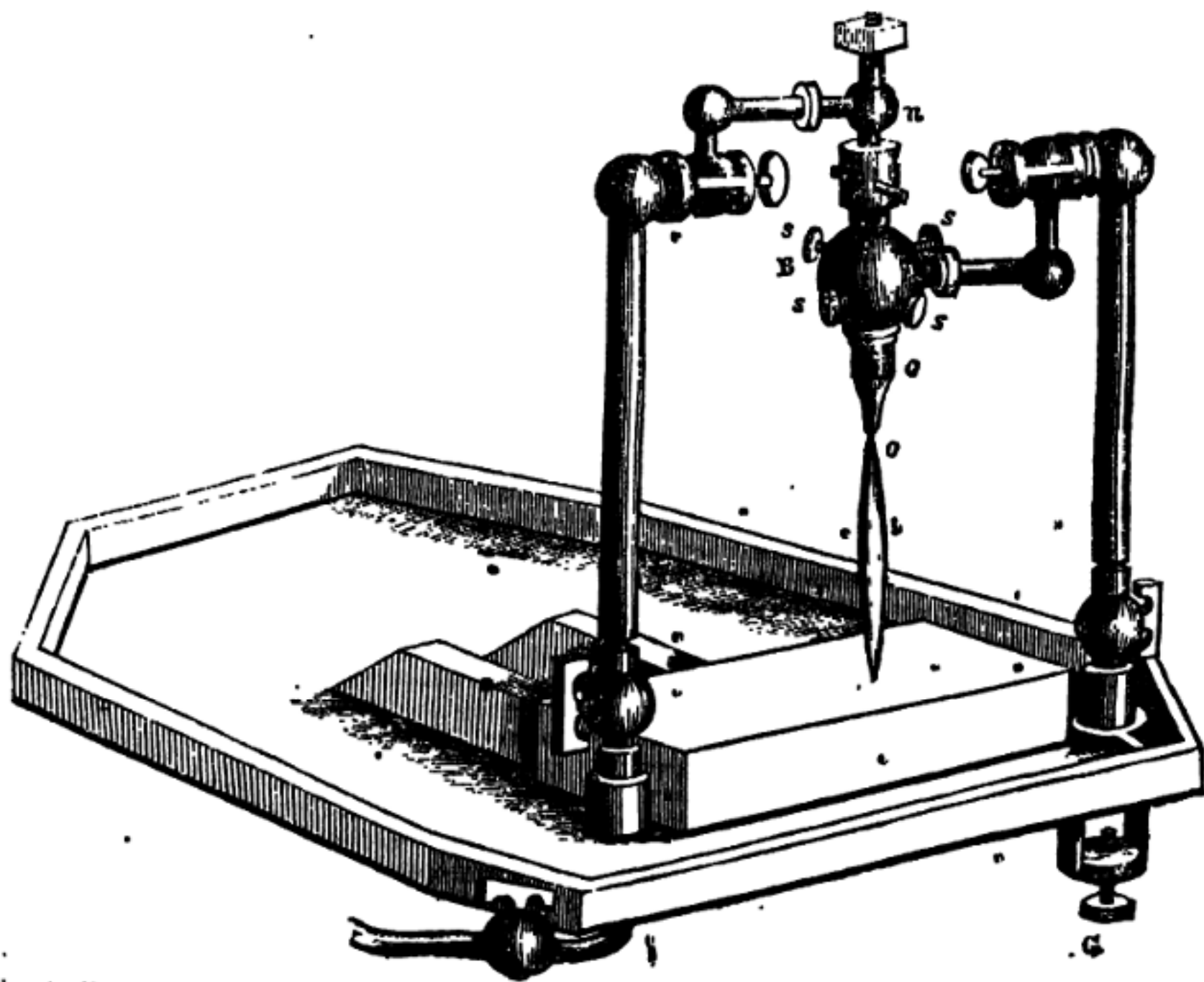
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Fig. 1.



PROFESSOR HARE'S BLOW-PIPES.



PROFESSOR HARE'S BLOW-PIPES.

THE instruments we have chosen for the present week's illustration are a hydrostatic blow-pipe and an oxy-hydrogen blow-pipe, both by Professor Hare, of Pennsylvania, in whose words they are described.

"The *hydrostatic blow-pipe*, (Fig. 1), consists of a cask, divided by a horizontal diaphragm into two apartments, D D. From the upper apartment a pipe of about three inches in diameter, its axis coincident with that of the cask, descends, until within about six inches of the bottom. On this is fastened by screws, a hollow cylinder of wood, B B, externally twelve inches, internally eight inches, in diameter. Around the rim of this cylinder, a piece of leather is nailed so as to be air-tight. On one side, a small groove is made in the upper surface of the block, so that a lateral passage may be left under the leather when nailed on each side of the groove. This lateral passage, communicates with a hole bored vertically into the wood by a centre-bit; and a small strip of the leather, being extended so as to cover this hole, is made, with the addition of some disks of metal, to constitute a valve, opening upwards. In the bottom of the cask there is another valve, opening upwards. A piston rod, passing perpendicularly through the pipe, from the handle, H, is fastened near its lower end, to a hemispherical mass of lead, L. The portion of the rod beyond this proceeds through the centre of the leather, which covers the cavity formed by the hollow cylinder; also through another mass of lead, like the first, which being forced up by a screw and nut, subjects the leather, between it and the upper leaden hemisphere, to a pressure sufficient to render the juncture air-tight. From the partition, an induction pipe is carried under the table, where it is fastened, by means of a screw, to a cock which carries a blow-pipe, so attached, by a small swivel joint, as to be adjusted into any direction which can be necessary. A suction pipe passes from the opening covered by the lower valve under the bottom of the cask, and rises vertically, close to it, on the outside—terminating in a staple, with a screw in it, *g*, for the attachment of any flexible tube which may be necessary.

"The apparatus being thus arranged, and the cask supplied with water, until the partition is covered, to the depth of about two inches, if the piston be lifted, the leather will be bulged up, and will remove, in some degree, the atmospheric pressure from the cavity beneath it; consequently, the air must enter through the lower valve to restore the equilibrium. When the piston is depressed, the leather being bulged in the opposite direction, the cavity beneath it is diminished, and the air, being compressed, forces its way through the lateral valve into the lower apartment of the cask. This apartment being previously full of water, a portion of this fluid is pressed up through the pipe into the upper apartment. The same result ensues every time that the stroke is repeated: so that the lower apartment soon becomes replete with air, which is retained by the cock, until its discharge by the blow-pipe is requisite.

"The cock being opened, the air confined in the lower apartment is expelled by the pressure of the water in the upper apartment, which, as the air which had displaced it escapes, descends, and re-occupies its former situation. The piston is worked either by the handle, or the treadle, at C.

"In order to supply the cask with oxygen gas, it is only necessary to attach to the suction pipe, by means of the staple and screw at *g*, another pipe, duly flexible, and passed under a bell containing the gas in question, over the pneumatic cistern. Or the pipe may communicate with a leather bag, filled with oxygen.

"Having used the hydrostatic blow-pipe for many years, I am enabled to speak in favor of its convenience, with the confidence due to this long trial. I am persuaded, that it would be found exceedingly useful to all artists who employ the blow-pipe in soldering, or in blowing or moulding the tubes of thermometers, barometers and other processes, to which the enameller's lamp is applied.

"The *compound blow-pipe*, represented in Fig. 2, is one which I contrived and executed myself; but fearing it might be deemed unnecessarily complex, I have never published any account of it. Experience has shown, that the complication of its structure does not render it more difficult to use than the simplest instruments intended for the same purpose; while its parts are peculiarly susceptible of advantageous adjustment.

"B is a brass ball, terminating in a male screw above, and in a female screw below. The ball has a vertical perforation which commences with the lower screw, and terminates with the upper one. Another perforation, at right angles to this, causes a communication with the tube, which enters the ball at right angles. A similar, but smaller brass ball, may be observed above, with perforations similar to those in the larger ball, and a tube in like manner entering it laterally. This ball terminates in a male screw below, as well as above; and the thread of the lower male screw is curved to the left, while that of the larger ball, which enters the same nut, *n*, is curved as usual, to the right: hence the same motion causes the male screws to approach, or recede from each other, and thus determines the degree of compression given to cork which is placed between them, in the nut. At the top of the ball, a small screw may be observed, with a square head. This is connected with a small tube which passes through a cork in the nut, and reaches nearly to the external orifice, from which the flame is represented as proceeding. This tube is for the most part of brass, but at its lower end terminates in a tube of platina. Into the female screw of the larger ball, a perforated cylinder of brass, *c*, with a corresponding male screw, is fitted. The perforation in this cylinder forms a continuation of that in the ball, but narrows below, and ends in a small hollow cylinder of platina, which forms the external orifice of the blow-pipe *o*.

"The screws *s s s s* are to keep, in the axis of the larger ball, the tube which passes through it, from the cavity of the smaller ball. The intermediate nut, by compressing about the tube the cork which surrounds it, prevents any communication between the cavities in the two balls. By the screw in the vertex, the orifice of the central tube may be adjusted to a proper distance from the external orifice. Three different cylinders, and as many central tubes, with platina orifices of different calibres, were provided, so that the flame might be varied in size, agreeably to the object in view.

"I have always deemed it best to transmit the oxygen gas through the tube in the axis; since two volumes of the hydrogen being required for one volume of oxygen, the larger tube ought to be used for the former; and the jet of hydrogen is placed

between a jet of oxygen, within it, and the atmospheric air without.

"Under the table is a frame, G, with a screw, for attaching a pipe, leading from a self-regulating reservoir of hydrogen."

ACTION OF WATER UPON GLASS.

It is a commonly received notion that glass is capable of resisting, to a very great extent, the active chemical solvents and that its alkali can neither be readily separated nor exhibited in an insulated form without regularly submitting it to powerful decomposing agents.—Speaking of glass, in common language, without any reference to the many soluble compounds so designated, it may be a new fact in chemistry to prove that this singular substance possesses highly alkaline properties, which may easily be shown by the usual tests.

Upon reducing some thick flint glass to a moderately fine powder in an earthenware mortar, for the purpose of analysis, a portion of it was placed on turmeric paper, with the view of determining if it possessed any sensible alkaline property; and, upon being moistened with water, the yellow color of the test-paper was instantly reddened nearly as powerfully as if lime had been employed.

This effect was considered as accidental, and as probably arising from some adventitious alkaline matter, or soap, adhering to the vessels employed. Another experiment was made, with greater care, in an agate mortar, but with the same, or even a more decided result, in consequence of the more minute division of the material. When pulverized on perfectly clean and polished surfaces of iron, steel, zinc, copper, silver, and platinum, the effect took place, and apparently with equal facility; but it was found that the presence of small quantities of oxide of iron greatly diminished it, in consequence, as was afterwards proved, of the particles of glass being by them defended from the contact of water.

Since there are some saline bodies and metallic combinations which give indications of alkali to turmeric-paper, although perfectly neutral compounds, and as pure magnesia reddens this paper when moistened with water, although no solution can be shown to take place, possibly this might be an effect of the kind, it scarcely appearing probable that any soluble matter should be abstracted from the powdered glass by the mere affusion of pure water. Litmus paper, therefore, reddened by an acid, and paper stained with the blue infusion of cabbage, were also employed as tests; the former had its blue color restored, and the latter was rendered green.

A portion of flint-glass in fine powder was boiled in water for some hours; upon being allowed to cool, and subside, the clear portion was decanted and evaporated, and became strongly alkaline to the taste, and to other usual tests; a drop of its concentrated solution, gradually evaporated on a glass plate, on exposure to the atmosphere, in a short time became deliquescent. Tartaric acid produced an effervescence, and afterwards a precipitate in this solution; as likewise did muriate of platinum. From these experiments, therefore, it may be fairly inferred that the alkali removed from the glass was potash in an uncombined state, and that the alkaline effect observed in the first instance did not depend upon the presence of any alkaline salts, or combination, adhering to or diffused throughout the glass.

The remaining sediment from the above solution,

after having been repeatedly washed in successive portions of water, became inert as to its action on test-papers, not affecting their colors in the slightest degree; but, upon *trituration*, its alkaline power was again developed; this property being evidently dependent upon the exposure of a new or underexposed surface. A slight application of heat to the water was found greatly to facilitate this evolution of alkali.

In order to determine the quantity of alkaline matter abstracted from a given weight of glass, by long and continued boiling, 100 grains of flint-glass, in fine powder, were boiled nearly every day for some weeks, in two or three successive portions of water; after this process, the insoluble residue was found deficient in weight by nearly seven grains. This result, however, must not be considered as accurate, but as a mere approximation: for, on the one hand, small portions of glass might have been carried away in the supernatant liquor; and, on the other, more alkali might have been abstracted by repeatedly triturating during the process, which, under these circumstances, would be almost unlimited.

To some pure dilute muriatic acid was added very fine flint-glass, in powder, till it was completely neutralized by its alkaline effect. Upon being allowed to subside, (which, however, was not very readily effected, minute particles remaining suspended for weeks together,) the clear portion afforded a crystalline salt on evaporation, having the characters of muriate of potash.

It may be remarked that this solution, when perfectly clear, contained no lead, on testing for it by sulphuretted hydrogen; but upon agitating or diffusing the fine powder of glass through water, holding the gas in solution, it was immediately discolored or blackened.

Flint-glass, although chosen for the above experiments, is not the only variety possessing this remarkable property, crown and plate-glass, white enamel, and what is more remarkable, Newcastle green-bottle glass, and tube of the same material, (in the composition of which there is, comparatively, little alkali,) also Reaumur's porcelain, made from the green bottle glass, possess the power of acting upon vegetable colors as alkalis.

These experiments, tending to prove that glass is a body of irregular composition, parting readily with its alkali by the action of water, it became a matter of some interest to determine how far certain natural combinations of potash with siliceous matter were equally active to the same tests, especially as in green-bottle glass, which contains little alkali, it is thus rendered evident. No analogous effect could, however, be produced by powders of felspar, basalt, green-stone, granite, obsidian, pumice, and some others, even when boiled with water, a method which never failed to produce it rapidly with glass, although cold water is perfectly sufficient.

Some interesting conclusions may be drawn from the above experiments, which may tend to explain several well-known phenomena.

In the first place, with regard to the glasses employed in the laboratory, or for domestic uses, it must be evident that water has the power of acting upon and dissolving the alkali at the surface, and leaving an insoluble portion spread as a coating over the interior of the vessel, defending it from further immediate action.

Where, however, time can be allowed, the effect does not appear to be confined to mere surface. In

collections of ancient glass, specimens may be selected, exhibiting how extensively an analogous action has been going on during the period they have remained buried in the earth. These vitreous relics of antiquity are often covered, to a considerable thickness, with opal pearly scales of beautiful appearance, consisting almost wholly of silica, whose alkali had been removed probably by the action of the water.

A fragment of transparent ancient glass was examined with regard to its alkaline property, which it was found to enjoy in a high degree, being sensibly alkaline (when in powder) to the tongue, and its hot solution acting upon the cuticle. It appeared to consist almost entirely of potash and silica; not the smallest trace of lead being discoverable in it; several other colored specimens of ancient glass, upon examination, were, in every case, more highly alkaline than any modern glass containing lead, that has hitherto been examined.

The specific gravity of common flint-glass was taken by way of comparison with the ancient fragments above mentioned, the result of which is here given. Flint-glass, S.G., 3.208. Ancient glass, 2.375. It may here be remarked, that the latter acted powerfully upon the test-paper, by merely moistening it, without reduction to powder. It cannot be surprising, therefore, that ancient glass, which may almost be called pure silicate of potash, should be occasionally found in states of such rapid decay, as the specimens in collections often exhibit.

Another proof of the action of water, aided by other concomitant circumstances, in producing decomposition upon glass, is an account given in vol. i. p. 135, of the *Technical Repository*, of some bottles of wine found in a quantity of black mud at the bottom of an old well, full of burned wood, supposed, upon good authority, to be of anterior date to the fire of London. The siliceous earth, in this instance, separated in films on the surface of the bottle, in consequence of the abstraction of alkaline matter, probably by the action of water, aided perhaps originally by a certain degree of heat, and afterwards by the long period of their continuance in a situation favorable to the decomposing agency.

In contact with ammoniacal, or decomposing animal matter, the disintegration of glass takes place more rapidly. Stable-windows, and bottles kept in such situations, often present a very beautiful iridescent appearance, in consequence of the siliceous matter being developed in thin plates on its surface, often amounting to a pearly, and sometimes almost metallic appearance; an effect which depends upon the polarization of light.

Solution of potash acts very rapidly upon glass, as the chemist often inconveniently learns by the effect produced upon the bulb of a thermometer, employed to determine its boiling point, and which is always found corroded to a considerable extent after the experiment.

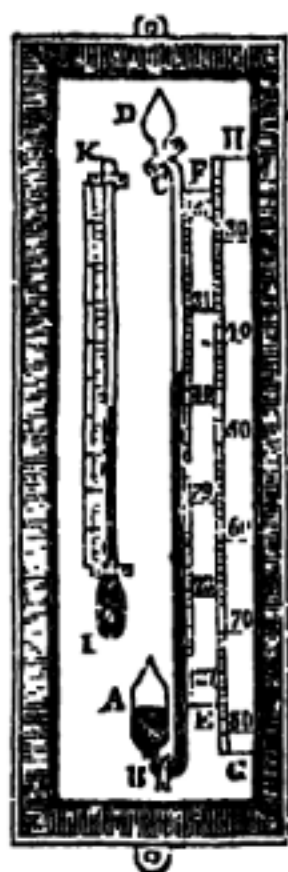
It may also here be remarked (although not perhaps immediately connected with the subject), that from frequent observations by a person in the habit of using solid carbonate of ammonia, that the flint-glass bottles in which it has been for some time kept are invariably rendered much more brittle, and pieces of glass fall out upon very slight motion of its contents. This fact is merely mentioned as curious, and may probably be hereafter more fully examined.

THE SYMPLESOMETER.

A SUBSTITUTE for the barometer was invented a few years ago by Mr. Adie, optician, of Edinburgh; it is thus described in the patent.

The principle of the instrument consists in measuring the weight of the air by the compression of a column of gas. It consists of a tube of glass ABCD about 18 inches long, and 0.7 of an inch diameter inside, terminated above by a bulb D, and having the lower extremity bent upward, and expanding into an oval cistern A, open at the top. The bulb D being filled with hydrogen gas, and a part of the

cistern A and the tube B, with almond oil, colored with anchusa root, the inclosed gas, by changing its bulk according to the pressure of the atmosphere on the oil in the cistern, produces a corresponding elevation or depression of the oil in the tube, thereby indicating the variations in the weight of the atmosphere. The scale for measuring these changes is determined by placing the instrument, with an accurate barometer and thermometer, in an apparatus where the air can be rarefied or condensed, so as to make the barometer stand at 27, 30, or any other number of inches. The different heights of the oil in the tube of the symplesometer, corresponding to those points, being marked on its scale E F, and the spaces between them being divided into 100



equal parts, these divisions represented hundredths of an inch in the mercurial column.

To correct the error that would arise from the change produced in the gas by variations of temperature, the principal scale E F is made to slide on another G H, so graduated, as to represent the amount of that change corresponding to the degrees of a thermometer, I K, attached to the instrument.

To use the instrument, note the height of the thermometer, and set the index *a*, which is upon the sliding scale, to the degree of temperature on the fixed scale; then the height of the oil, as indicated by the scale, is the pressure of the air, or the height of the mercury in the barometer at the time. The sliding scale is moved by means of a knob.

This instrument has been thought to afford more delicate indications than the barometer of changes in the atmospheric pressure; and the pressure determined by an instrument of this kind has been found to agree very well with those given by the barometer, not differing more than from the eighth to the thirtieth part of an inch.

ROTATORY MOTION OF A WATCH GLASS.

(To the Editor.)

SIR,—Having observed that you had inserted on p. 136 of the first vol. of your Magazine the following *Query*:—"What is the cause of the rotatory motion acquired by a watch-glass when placed on an inclined looking-glass in its progress to the bottom?"—and also that on p. 143 of the same volume, the following was the only reply that had been made to it, viz:—"There is no cause for a nonentity; it is not a fact that it does so."—I was led to endeavour to repeat the experiment, and although I have not suc-

ceeded in performing it exactly in the manner proposed in the query, I trust the mode I have adopted, and the few suggestions I may have to make upon it, may not be inappropriate, but be the means of throwing some light upon the cause of such a strange phenomenon.

If you take a large common writing-slate, and pour a very small quantity of water upon one of its surfaces, taking care that it shall be spread pretty equally all over it, and place a thin well-formed watch-glass upon any part of it,—as soon as you incline the slate in any direction, you will perceive the watch-glass begin to move towards the most depending part, acquiring a rotatory motion in its descent,—and by repeatedly altering the inclination of the slate, you may cause it to follow any direction. The only thing of consequence to be attended to in performing the experiment, is to make use of just as much water as shall cause a slight attraction between the glass and the slate, and yet not materially impede its progress. I find it sometimes requisite to shake the slate a little from side to side before the glass will begin to move; but when once set a-going, there is no difficulty in keeping up the movement. I cannot succeed so well with a dry slate nor with a looking-glass, when dry, but if slightly wetted, it answers quite as well as the slate.*

If you perform it as above, you cannot fail to notice the following facts:—Place the slate quite level and put the glass on any part of it, and observe that a small quantity of water will be drawn up by capillary attraction, and remain between the bottom of the glass and the surface of the slate. (I may here remark, that this drop should never be allowed to exceed the size of the end of a common lead pencil). You will also perceive that it is circular, and provided the glass be well formed, and the slate perfectly level, invariably in the centre. This is eventually to become the point on which the glass is to rotate. Now no sooner do you incline the slate to one side than the whole mass of water gravitates to the lowest part; and with it to a certain amount, the aforesaid drop of water. Hence, wherever the glass may be situated, if it revolve at all, it must do so eccentrically, that is to say, the upper half will always have the longer radius, which being equivalent to a longer lever, will enable it to act with greater power; but as soon as it has performed half a revolution, the whole arrangement will be changed, the relative position of the circumference of the glass and the rotating point being exactly reversed; this in its turn will again perform another half revolution, since it will be acting with a longer radius, which together with its disposition to slide down the slate will enable it to raise the lower and opposite side.

Successive repetitions of such actions would, I think, account for its revolving—if I be correct in asserting that it does so eccentrically; but I think on consideration, we may safely conclude that it could not be otherwise; for supposing it were *central*, then every part of the circumference would be equally balanced by that diametrically opposed to it, and it must necessarily remain at rest, or at all events merely slide downwards, attracted by the force of its own gravity.

Moreover, not only is this point eccentric, but it is constantly varying in relative position with regard to the rest of the glass; for supposing it were eccentric, and yet not capable of being so altered, and that the larger half happened to be highest in the first instance, all that would occur would be, that it

would perform but half a revolution, bringing this to the lowest point, and there remain without the slightest attempt at rotatory motion.

If you should consider this explanation correct, and will honor it with a place in your Magazine, you will greatly oblige

R. L.

Faversham, Kent, May 16, 1842.

DOMESTIC DYEING.

BLUE DYES.

THE only coloring matters employed in dyeing blue are woad and indigo.

Woad is a plant cultivated in this kingdom, and even grows wild in some parts of England. Indigo is a blue powder, extracted from a species of plant which is cultivated for that purpose in the East and West Indies. These plants contain a peculiar green matter, which in that state is soluble in water. This matter has a strong affinity for oxygen, which it attracts greedily from the atmosphere; in consequence of which it assumes a *blue* color, and becomes insoluble in water.

Indigo has a very strong affinity for wool, silk, cotton, and linen. Every kind of cloth, therefore, may be dyed with it, without the assistance of any mordant whatever. The color thus induced is very permanent; because the indigo is already saturated with oxygen, and because it is not liable to be decomposed by those substances, to the action of which the cloth is exposed. But it can only be applied to cloth in a state of solution; and the only solvent known being sulphuric acid, it would seem at first sight, that the sulphuric acid solution is the only state in which indigo can be employed as a dye.

To dye wool blue.—One part of indigo is to be dissolved in four parts of concentrated sulphuric acid; to the solution, one part of dry carbonate of potash is to be added, and then it is to be diluted with eight times its weight of water. The cloth must be boiled for an hour in a solution, containing five parts of alum and three of tartar, for every 32 parts of cloth. It is then to be thrown into a water bath, containing a greater, or smaller proportion of the diluted sulphate of indigo, according to the shade which the cloth is intended to receive. In this bath it must be boiled till it has acquired the wished-for color.

The alum and tartar are not intended to act as mordants, but to facilitate the decomposition of the sulphate of indigo. The alkali added to the sulphate answers the same purpose. These substances, also, by saturating part of the sulphuric acid, serve, in some measure, to prevent the texture of the cloth from being injured by the action of the acid, which is very apt to happen in this process.

But sulphate of indigo is by no means the only solution of that pigment employed in dyeing. By far the most common method is, to deprive indigo of the oxygen, to which it owes its blue color, and thus to reduce it to the state of green matter; and then to dissolve it in water, by means of alkalis, or alkaline earths, which, in that state, act upon it very readily.

Two different methods are employed for this purpose. The first of these methods is, to mix with indigo a solution of some substance which has a stronger affinity for oxygen than the green basis of indigo; green oxide of iron, for instance, and different metallic sulphurets. If, therefore, indigo, lime, and sulphate of iron, are mixed together in

water, the indigo gradually loses its blue color, becomes green, and is dissolved: while the black oxide of iron is converted into the red oxide. The manner in which these changes take place is obvious; part of the lime decomposes the sulphate of iron; the black oxide, the instant that it is set at liberty, attracts oxygen from the indigo, decomposes it, and reduces it to the state of green matter. This green matter is immediately dissolved by the action of the rest of the lime.

The second method is, to mix the indigo, in water, with certain vegetable substances which readily undergo fermentation; the indigo is deprived of its oxygen, and dissolved by means of quick-lime or alkali, which is added to the solution. The first of these methods is usually followed in dyeing cotton and linen; the second, in dyeing wool and silk.

In the dyeing of wool, woad and bran are commonly employed as vegetable ferments, and lime as the solvent of the green base of the indigo. Woad itself contains a coloring matter precisely similar to indigo; and by following the common process, indigo may be extracted from it. In the usual state of woad, when purchased by the dyer, the indigo, which it contains, is probably not far from the state of green matter. Its quantity in woad is but small, and it is mixed with a great proportion of other vegetable matters.

When the cloth is first taken out of the vat, it is of a green color; but it soon becomes blue, by attracting oxygen from the air. It ought to be carefully washed, to carry off the uncombined particles. This solution of indigo is liable to two inconveniences: first, it is apt sometimes to run too fast into the putrid fermentation; this may be known by the putrid vapors which it exhales, and by the disappearing of the green color. In this state it would soon destroy the indigo altogether. The inconvenience is remedied by adding more lime, which has the property of moderating the putrescent tendency. Secondly, sometimes the fermentation goes on too languidly. This defect is remedied by adding more bran, or woad, in order to diminish the proportion of quick-lime.

To dye silk blue.—Silk is dyed light-blue by a ferment of six parts of bran, six of indigo, six of potass, and one of madder. To dye it of a dark blue, it must previously receive what is called a *ground color*; a red dye-stuff, called archil, is used for this purpose.

To dye cotton and linen blue.—Cotton and linen are dyed blue by a solution of one part of indigo, one part of green sulphate of iron, and two parts of quick-lime.

YELLOW DYES.

The principal coloring matters for dyeing yellow, are weld, fustic, and quercitron bark.

Weld is a plant which grows commonly in this country; fustic is the wood of a large tree which grows in the West Indies, and quercitron is a tree growing in North America, the bark of which contains coloring matter.

Yellow coloring matters have too weak an affinity for cloth, to produce permanent colors without the use of mordants. Cloth, therefore, before it is dyed yellow, is always prepared by combining some mordant or other with it. The mordant most commonly employed for this purpose is alumine. Oxide of tin is sometimes used when very fine yellows are wanting. Tan is often employed as subsidiary to alumine, and in order to fix it more copiously on cotton and linen. Tartar is also used

as an auxiliary, to brighten the color; and muriate of soda, sulphate of lime, and even sulphate of iron, in order to render the shade deeper.

The yellow dye by means of fustic is more permanent, but not so beautiful as that given by weld, or quercitron. As it is permanent, and not much injured by acids, it is often used in dyeing compound colors, where a yellow is required. The mordant is alumine. When the mordant is oxide of iron, fustic dyes a good permanent drab color.

Weld and quercitron bark yield nearly the same kind of color; but as the bark yields coloring matter in much greater abundance, it is much more convenient, and upon the whole, cheaper than weld. It is probable, therefore, that it will gradually supersede the use of that plant. The method of using each of these dye-stuffs is nearly the same.

To dye woollens yellow.—Wool may be dyed yellow by the following process: let it be boiled for an hour, or more, with about one-sixth of its weight of alum, dissolved in a sufficient quantity of water. It is then to be plunged, without being rinsed, into a bath of warm water, containing as much quercitron bark, as equals the weight of the alum employed as a mordant. The cloth is to be turned through the boiling liquid, till it has acquired the intended color. Then, a quantity of clean powdered chalk, equal to the hundredth part of the weight of the cloth, is to be stirred in, and the operation of dyeing continued for eight or ten minutes longer. By this method a pretty deep and lively yellow may be given, fully as permanent as weld yellow.

For very bright orange, or golden yellow, it is necessary to have recourse to the oxide of tin as a mordant. For producing bright golden yellows, some alum must be added along with the tin. In order to give the yellow that delicate green shade so much admired for certain purposes, tartar must be added in different proportions, according to the shade. By adding a small portion of cochineal, the color may be raised to a fine orange, or even to an aurora.

To dye silks yellow.—Silk may be dyed of different shades of yellow, either by weld or quercitron bark, but the last is the cheaper of the two. The proportion should be from one to two parts of the bark to twelve parts of silk, according to the shade. The bark, tied up in a bag, should be put into the dyeing vessel, whilst the water which it contains is cold; and when it has acquired the heat of about 100°, the silk, having been previously alumed, should be dipped in, and continued, till it assumes the wished-for color. When the shade is required to be deep, a little chalk, or pearl-ash, should be added towards the end of the operation.

To dye linens and cottons yellow.—The best method of dyeing cotton and linen yellow is as follows:—The mordant should be acetate of alumine, prepared by dissolving one part of acetate of lead, and three parts of alum, in a sufficient quantity of water. This solution should be heated to the temperature of 100°: the cloth should be soaked in it for two hours, then wrung out and dried. The soaking may be repeated, and the cloth again dried as before. It is then to be barely wetted with lime water, and afterwards dried. The soaking in the acetate of alumine may be again repeated; and if the shade of yellow is required to be very bright and durable, the alternate wetting with lime-water and soaking in the mordant may be repeated three or four times. By this contrivance, a sufficient quantity of alumine is combined with the cloth, and the combination is

rendered more permanent by the addition of lime. The dyeing-bath is prepared by putting twelve or eighteen parts of quercitron bark (according to the depth of the shade required), tied up in a bag, into a sufficient quantity of cold water. Into this bath the cloth is to be put, and turned round in it for an hour, while its temperature is gradually raised to about 120°. It is then to be brought to a boiling heat, and the cloth allowed to remain in it, after that, only for a few minutes. If it is kept long at a boiling heat, the yellow acquires a shade of brown.

(To be continued.)

SCHOOLS OF ART.

THE amateurs of the arts of design understand by this term certain classes of artists, whose works are all referable to one common origin. The phrase, however, takes at times a more limited meaning, and refers to the followers of one particular master, and thus we say, the school of Raffaele, the school of Rubens, &c. In the first and most comprehensive sense, however, the schools of painting may be divided into nine; namely, the Florentine, the Roman, the Venetian, the Lombard, the Flemish, the Dutch, the German, the French, and the English.

The several manners of imitating nature, which have peculiarly characterised different countries, have given rise to the diversity of schools. This diversity has existed at all times. The Grecians adopted, recognised, and distinguished these varieties. In painting they at first distinguished two celebrated schools, the Hellenic and the Asiatic. Eupompus, the painter of Sicily, invented in Greece a new manner; and in honor of him, says Pliny, they divided the Hellenic school into two;—namely, the Attic and the Sicilian.

In architecture, the term has not been so commonly used; though not because that art is wanting in celebrated masters, who have brought up numerous pupils, and have transmitted to them their own style. Palladio, for instance, is the chief of an extensive school. But it should seem that variety of style, in architecture, is less sensible than in the other imitative arts; and it has been even remarked, that many modern architects, whose names stand out from the general list as having acquired a great degree of celebrity, are indebted more to novelty and caprice than to real and abiding invention. There are, at the same time, in architecture, various local manners of building, dependent either on climate, materials, or some other arbitrary cause, which, in the commencement of the art, have become, almost insensibly, the principles of its development, and may consequently be ranged into schools. Thus we speak of the Florentine school, at the head of which may be placed Brunelleschi and Michel Angiolo; the Venetian, which is led by Palladio and Scamozzi, &c.

The Florentine School.—For many ages the city of Florence has been one of the principal seats of the fine arts; and has produced, in all their various branches, a number of justly eminent professors. It is requisite to distinguish the elder from the more modern Florentine school. Ever since the thirteenth century Florence has obtained high reputation as the seat of art. Its senate introduced several artists from Greece, by whom the style and taste of the students were formed; and hence arose the elder Florentine school, at the head of which stands Cimabue, and which may be said to comprise all the painters of Italy worthy notice until the appearance

of Lionardo da Vinci, with whom commenced the modern Florentine school, and who was followed by Michel Angiolo, and a list of other great masters. The leading principles of the Florentine school may be denominated grandeur, dignity and force.

The Roman School is, perhaps, the most important of any, a circumstance which may fairly be attributed to that city having been so rich in the productions of ancient Grecian art. It was the intense study of these inestimable relics of antiquity that formed the groundwork of the Roman school of painting, although in its progress it was mixed up a good deal both with the Florentine and Venetian schools. Raffaele, for instance, the greatest name belonging to the Roman school, and perhaps to the art altogether, evidently was indebted, and that largely, for the style of his grander works, to the stupendous genius of Michel Angiolo. To this school, however, we may justly attribute the truest principles and the finest examples of drawing, as well as of that scrupulous correctness which, nevertheless, was quite consistent with vigour and with beauty. Its followers were also eminent for their knowledge in the department of drapery, which knowledge they generally displayed in adopting ample and flowing robes and vestments, as may be observed in the matchless cartoons which form the chief ornament of Hampton Court. On the other hand, one must not seek, in this school, for any very superior exhibition of coloring: indeed, its artists seem to have been too intent on other branches of art, such as we have mentioned—on majesty, composition, and striking effects, to regard with any close attention the varieties and splendors of color. The Roman school comprised, besides Raffaele, Giulio Romano, the Zuccheri, Romanelli, Gaspar Poussin, Carlo Maratti, &c.

The Venetian School presents a great variety, whether we view it relatively to the Florentine or the Roman. Destitute of the examples which the elder Florentine school presented to its later offspring, and also of the far more brilliant advantages possessed by the followers of the Roman school, the Venetian artists applied themselves ardently to the contemplation of nature, and seized upon a source of fascination which had been in a great measure disregarded by their predecessors, namely, color. Here start up to our view the most exquisite and brilliant arrangements of tints; and the delighted fancy of the connoisseur revels among the productions of the great prince of this department of the art, Titian. To this exalted master, artists of other schools have, we know, been opposed. Both Rubens and Van Dyck have partisans, who claim for each the title of chief colorist. Rubens is more meretricious and less true, and Van Dyck, admirable as he is, seems inferior both in variety and richness. Tintoret, Paul Veronese, Giorgione, Sebastian del Piombo, &c. adorn with their illustrious names the Venetian school of painting; and the performances of all are more or less imbued with its peculiar characteristics; namely, vivacity and truth of color, perfect distribution of light and shade, boldness of touch, and correct eye for nature. They sought out those scenes in landscape, as well as other subjects, wherein the contrasts, the assimilations, or combinations of color presented the opportunity of exhibiting their greatest fascination. It should be remarked, however, that one explanation of this predominating excellence in the Venetian school may be afforded by the circumstance of the Florentine and Roman artists painting chiefly in fresco and

water colors, whilst Titian and his celebrated brethren preferred the use of oils. The portraits of Titian, too, which are numerous, led him to acquire great skill and display of coloring, since he was constrained to be correct and glowing in his carnations, draperies, &c.

The Lombard School, sometimes denominated the Bolognese, or Eclectic (Bologna having been its principal seat), was established by the Caracci. It was an attempt to combine and harmonize all the beauties of the different styles which had preceded it; but, although the idea was comprehensive and fine, and manifested uncommon grasp and power in the minds of its suggestors, its unfixed, heterogeneous nature prevented it from holding together, and its avowed followers soon separated, each taking that particular path to which his individual genius appeared to impel him. It is common to rank among the Bolognese artists Corregio, Domenichino, Guido, Lanfranco, Caravaggio, Primaticcio, Schidone, Zampieri, &c. of whom Domenichino may be said to have endeavoured most zealously to pursue the plan of the founders of his school.

The German School may be said to have originated with Albert Durer, although he neither reared scholars nor was imitated by the German artists of that or the succeeding century. The indiscriminate use of the words genius and talent has, perhaps, no where caused more confusion than in the classification of artists. Albert Durer has been characterised as a man of great ingenuity without being a genius. "He studied, and as far as his penetration reached established certain proportions of the human frame; but he did not invent a style. Every work of his is a proof that he wanted the power of imitation, of concluding from what he saw to what he did not see, that he copied rather than selected the forms which surrounded him, without remorse tacking deformity and meagreness to fullness, and sometimes to beauty."

Besides Durer, we may reckon in the German school, or it would be, perhaps, more correct to say, among the German artists, Lucas of Leyden, Marc Antonio (the engraver of Raffaele), Holbein, Netscher, Mengs, &c.

The Flemish School ordinarily comprises all the celebrated painters and sculptors of the low countries, including Spaniards and Austrians. These countries, more particularly Brabant and Flanders, were long the chief seats of industry and riches, and consequently of the arts springing therefrom. We may say, speaking generally, that this school carried to the highest point of perfection that imitation of nature which is contented with drawing from her most ordinary and uninviting moods, and takes no pains whatever to select or improve. The Flemish artists were also gifted with an abundant taste for character of the lower and more familiar description, and with great apprehension of the humorous. The name of Teniers must be, of course, well known to every admirer of art; and he is at the head of a long list of names eminent in a similar walk, and Van Dyck, the prince of portrait painters, also belonged to this school, and among its other illustrious ornaments we may particularize Steenwick, Spranger, Snuyders, Neefs, &c. The Flemish school is likewise extremely famous for its skill in coloring, and, as has been before observed, authorities have varied as to the palm of excellence in that particular between it and the Venetian school.

The Dutch School is not materially distinguished from the preceding; but since it has obtained a separate notice in many of the enumerations, we afford it one also here. The Dutch painters seem to have carried to a still greater extent than the Flemish the principle of taking Nature as they found her, without any regard to selection or embellishment. They made choice of the lowest of subjects; and hence we so frequently find the scenes of their pictures laid in taverns, workshops, or watchhouses. They were very fond of representing the noisy and drunken revels of villagers; and their success in this walk is unquestionably surprising. Their paintings are crowded with figures, just as they happen to come. Their heads are unintellectual, ugly and vulgar; but at the same time characteristic and various, and often grotesque. They held not back their hand, whatever the nature of object which might seem incidental to such scenes, and the postures and occupations of many of their figures are consequently quite revolting. This kind of taste must be admitted to be execrable; and yet the uncommon, the almost supernatural reality of the representation goes a great way towards redeeming it. Hagerdon was so struck with this, that he denominated this school—the school of truth.

These artists almost all challenge the praise of extreme neatness of execution and beautiful finish. They succeed, above all, in producing piquant results of *chiaro-scuro*, such as those of a strong light in a small inclosed space, effects of torchlight, or of the fire of a forge, &c. They have likewise been considered eminent in the representation of perspective, of sky, of marine subjects, fruits, animals, &c. as well as the lesser kind of portraits, and, in short, of all that depends chiefly on a correct eye and a delicate handling.

It must never be forgotten, in speaking and thinking of the Dutch school, that at its head stands one of the mightiest names in the art, whether ancient or modern; we allude to Rembrandt Van Rhyn. A thoughtful observation of his pictures inclines us sometimes to place him at the very summit of his art, so powerful is the impression made by his works on the imagination and feelings. A memorable instance of this occurs in the case of a little cabinet picture by him in the Dulwich Gallery, the subject of which is *Jacob's Dream*. Here, in spite of the vulgar appearance of Jacob himself, (who looks like an old Jew clothesman), and of the perfectly nondescript figures of the "angels ascending and descending the ladder," an effect is produced almost indescribable, and which, once witnessed, can never be forgotten. The dark heavy sky and landscape, which send their loneliness into the very heart of the spectator;—the radiant column which the grand fancy of the artist has substituted for any resemblance of a ladder; the sleeping figure stretched out below, and but half descried in the gloom; and the undefined, muffled, shapeless phantoms with outspread wings hovering upon the pillar of light,—form unitedly a resistless appeal to the inmost region of the imagination. The picture hangs on one's remembrance like a vivid dream: or rather like what the exalted painter meant, a sort of glimpse into the shadowy precincts of futurity. We may also affix honorable mention to the names of De Laide, Heemskirk, Pulembourg, Wouvermans, Vandervelde, Gerard Dow, Mieris, &c.

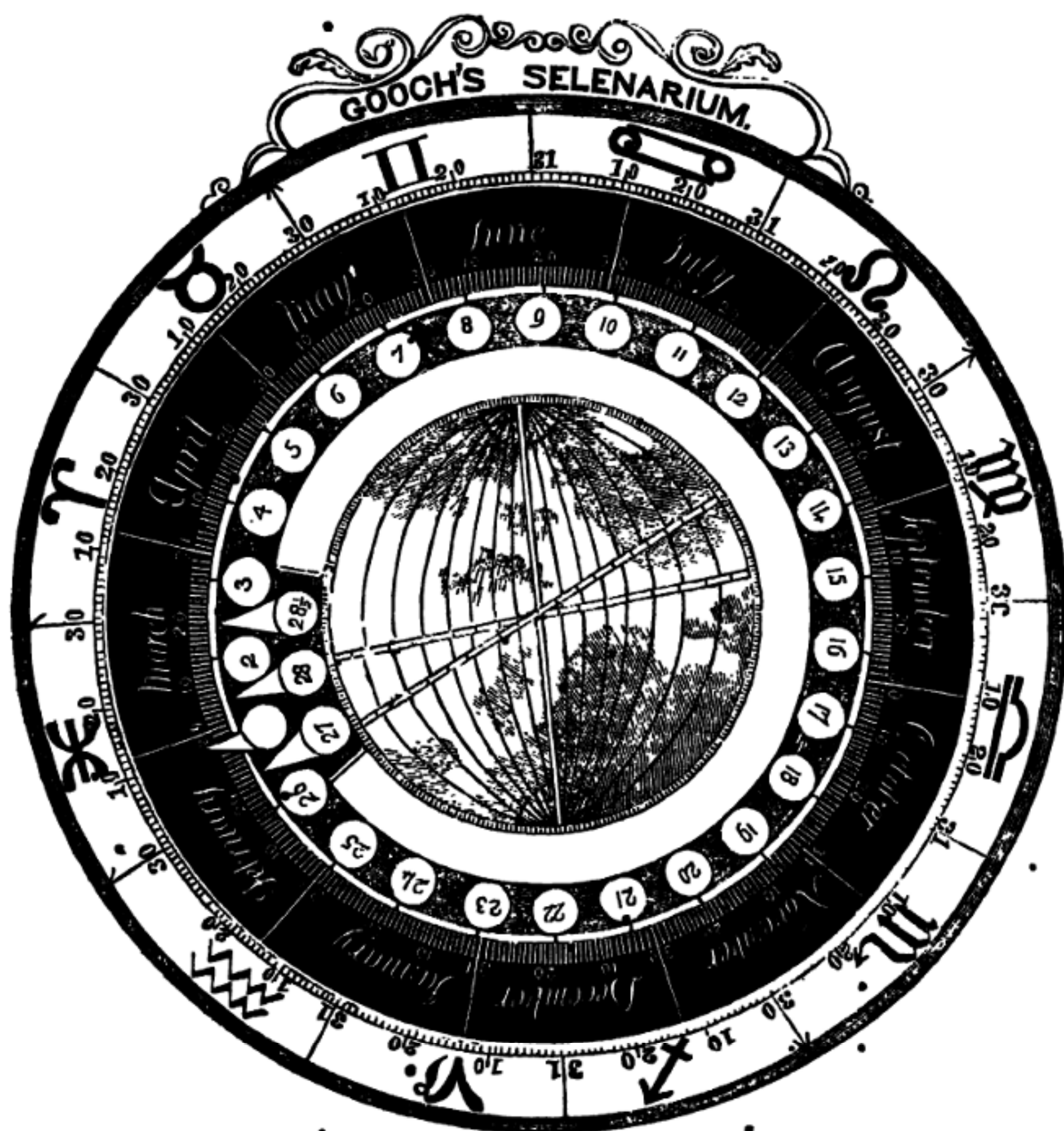
(To be continued.)

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NEW EDITION.

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INSTRUMENT FOR ASCERTAINING THE MOON'S
POSITION, &c.

THE SELENARIUM.

(To the Editor)

SIR.—I send you the draft of a selenarium, or instrument whereby to ascertain various particulars of the moon, her position among the signs, &c. To describe the instrument, let the drawing be considered as pasted down upon a piece of pasteboard, so that the circles of the signs, and of the days of the month, are fixtures. Previous to this part or rim being pasted down, cut out the central part containing the earth, and the various circles numbered from 1 to $28\frac{1}{2}$ of the moon's age; let this part be pasted on another piece of pasteboard, and when so pasted, let it be attached to the former rim by a piece of silk or thread running through the centre, a knot being made on each side to keep it in its place. Thus the central part will turn round upon the other, and the silk cord being left 2 or 3 inches long on the upper side may be drawn across the surface of both when required. The following example may illustrate the contrivance:—To find the sign the moon is in at any given time by this instrument, first seek in any common almanac of the year the time of the last new moon—place the new moon on the dial plate to the day of the month given, move the index, or *silken thread*, over the day of the lunar month or moon's age, and the sign and degree the moon is in at that time will be shown in the zodiac or outer circle.

Example.—Suppose a new moon take place on the 9th day of August, the conjunction will be in the sign Leo, about 17° ; then, suppose the moon to be 10 days old when you seek her place, by carrying the thread to the 10th day, it will be found to cut the zodiac at about 19° in the sign of Sagittarius, the place of the moon at that time, and so on at any time.

I am, your's, &c., B. GOOCH.

REMOVING PAINTINGS FROM WALLS, &c.

BY MR. R. SALMON.

THE first thing to be attended to, either for paintings on plaster walls or ceilings, or from boards, is, that the place in which they are be secure from wet or damp. If the paintings are on old walls, in large buildings, and places where this cannot be attained by art, then the summer season should be taken for the purpose, as the picture would rarely escape damage if the wet or damp gets at it while under the process; at the same time caution should be taken that the room or place be not overheated, which would also produce equally bad effects: these precautions taken, the next thing is to examine the face of the painting. If there are any holes in the same, they must be carefully filled up with paste, or putty of glue and whiting: this, if the holes are large, should be twice or thrice done, so as entirely to fill up and leave the face even and smooth; but if there are any bruised places, with paint still remaining on the face of the bruised parts, then this stopping must not be applied, but the securing canvass, hereafter described, be pressed down into these places. In the places that are stopped, there will of course appear blemishes when the picture is transferred; but the process is rendered much more certain and sure by being so done. Attention must next be paid to lay down any blisters, or places where the paint is leaving the ground: this is done by introducing, between the paint and the ground, some very strong paste of flour and water; and the face of the blistered paint being damped with a wet

sponge or pencil, it may then be pressed with the hand home to the ground, to which it will then adhere: all the unsound places being thus secured, care must be taken to clear the face of any grease or dirt, as also of any particles of the paste that may happen to be left on the surface. The next thing is, to determine the size of the painting meant to be taken off; and if on a plain surface, a board of the size of the picture must be procured, of not less than an inch in thickness, and framed together with well-seasoned wood, in small pannels, smooth and flush on one side: this done, a piece of fine open canvass must be provided, such as the finest sort used for hanging paper on: this canvass to be made somewhat larger than the picture, and so sewed together, and the seam pressed, that it be perfectly smooth and even. This is what I call the securing canvass, which, being so prepared, is then stuck on the face of the picture with a paste made of strong beer, boiled till it is half reduced, and then mixed with a sufficient quantity of flour to give it a very strong consistence. To large pictures on walls or ceilings the canvass must for some time be pressed, and rubbed with the hand as smooth as possible, working it from the middle to the outside, so as to make it tolerably tight, and observing, as it dries, to press it with the hand or cloth into any hollow or bruised places, so that it may adhere to every part of the painting: this done, it is left to dry, which it will mostly do in a day or two. When dry, a second canvass, of a stronger and closer sort, and of the same size as the other, is in like manner to be attached on the top of the first. This last will want very little attention, as it will readily adhere to the first; and, being dry, attention must be paid to the face thereof, to take off any small knots or unevenness thereon; which done, the whole should be again covered with a thin paste of size and whiting; when dry, to be pumiced over, so as to make the whole perfectly smooth and even. The painting being thus secured, the board, already prepared to the size of the picture, is to be put with the smooth side against the face thereof, so as exactly to cover as much as is intended to be transferred. The edges of the canvass, which, as before directed, are left larger than the painting, are then to be pulled tight over, and closely nailed to the edge of the board. If the painting be large, either on ceilings or walls, the board must, by proper supports, be firmly fixed against the picture, so that it can readily be lowered down when the plaster and painting is detached.

The canvass and board being fixed, the paintings from walls or ceilings are to be freed, together with a certain portion of the plastering: this, with a proper care and attention, may be readily done. If on a ceiling, the first thing is to make some holes through the plastering round the outside of the board and painting, and, with a small saw, to saw the plastering from one hole to another, till the whole is disunited from the other parts of the ceiling; this done the workman must get at the upper side of the ceiling, where he must free the plastering from the laths, by breaking off the keys thereof, and with a chisel cut out the laths whereby the plastering, together with the picture, will be left resting on the board and supports: if there be apartments over the ceiling, the readiest way will be, to take up a few of the floor boards above; if next the roof, means may always be found to get into the same.

If the painting is on a brick or stone wall, the same must be cut away at top, and down the sides

of the painting; and then, by means of chisels or saws in wood handles, of different lengths, the wall must be cut away quite behind the painting, leaving the same, together with the plastering, resting on the board; this operation may sometimes be done with a saw, or, if the wall be not thick, nor the other side of much consequence, the bricks or stones may be taken out from that side, leaving the plastering and painting as before. This last method I have not practised; the other, of cutting away some part of the wall, I have, and see no difficulty, or very great labour in the operation; but that of course must be various, according to the texture of the wall and mortar.

If paintings are on curved surfaces, such as the coves of ceilings, then the only difference of operation is, that some ribs of wood must be cut out and boarded smooth to the curve of the surface of the painting, and fixed up thereto, in place of the before described bearing board; the painting is then to be freed, and left with the plastering resting on the bearers.

For paintings painted on wainscot or boards, the same securing and process is exactly followed, only that, as the wainscot or board can always be cut to the size wanted, and laid horizontal, the securing canvass is stretched thereon, and turned over the edges of the same till it is dry; after which the edges are again turned up and nailed to the board in the same manner as those from walls.

Having, as before described in any of the aforementioned cases, freed the paintings from their original places, you have then got them secured to two thicknesses of canvass, with their faces next and on to the board prepared for that purpose; which being the case, they can readily be removed to any room or shop to be finished, as follows:—Having got the painting into the shop or room, which should be moderately warm and dry, but by no means overheated, laying the board on a bench or tressels, the back of the picture will be uppermost, and the plastering or wood, as may happen, is then to be cleared away, leaving nothing but the body of paint, which will be firmly attached to the securing canvass; to perform this a large rasp, a narrow plane, and chisels will be requisite: this operation is difficult to describe, but would soon be learned by any one who makes the attempt; nor is it very tedious; and being performed, the picture is ready to be attached to its new canvass, as follows:—The painting being cleaned, and lying on the board, the back thereof is to be painted successively, three or four times over, with any good strong-bodied paint, leaving each coat to dry before the other comes on; a day or two between each will generally be found sufficient. Each of these coats, and particularly the first, should be laid on with great care, taking but a small quantity in the brush at a time, and laying it very thin: this precaution is necessary to prevent any of the oil or paint from searching through any small cracks or holes that may happen to be in the face of the picture, which would run into the paste, and so attach the securing canvass to the picture as to prevent its being afterwards got off. If any of these holes or cracks are observed, they should be stopped up with the glue and whiting paste, and the painting then repeated till a complete coat is formed on the back of the picture; and it is then ready for attaching to its canvass, which is done by spreading all over the picture a paste made of copal varnish mixed with stiff white lead, and a small quantity of any other old fat paint; all of which being spread

equally over with a pallet knife, such a canvass as the first securing-canvass is laid thereon, and strained and nailed round the edges of the board, in which state it is left till it becomes tolerably dry; and then a second canvass, of a stronger sort, must be in like manner attached on the first, and left till it is perfectly dry and hard. This mostly takes about two months; and the longer it is left the more secure the painting will be attached to its canvass, and less liable to crack or fly therefrom. When sufficiently dry, all the four canvasses are to be unnailed from the board and the edges turned up the reverse way, and nailed to a proper stretching frame; this is done by unnauling from the board a part on each side at a time, and immediately nailing it to the stretching frame, so as never to leave the canvass to rack or partially stretch, which would damage the picture; in this manner, by degrees, the cloths are entirely detached from the board, and firmly fixed on the stretching frame; the superfluous canvass left larger than the frame may then be cut off, and the wedges put in the frame, and moderately tightened up. There remains then only to clear the face of the painting from the securing canvass, which is done by repeatedly washing the face with a sponge and moderately warm water; in doing this, no violence or force must be used; with frequent and gentle washings the paste will all be worked out with the sponge: the edges of the outer canvass are then to be cut round and stripped off, and the other next the face of the picture is to be done in like manner; which done, there only remains to clear the paste clean off, and repair any defects, and the picture will be as strong as if painted on the canvass.

For taking pictures off walls, without taking the walls down, or cutting away more thereof than the plastering, the following process is proposed:—The face of the picture to be first secured, in every respect, in the manner before described: instead of the plain board, a bearer should be prepared with a convex surface, composed of ribs boarded over, so as to form part of a cylinder, of not less than five feet radius, and as long as the height of the picture. This bearer being prepared, in order to apply it, a floor or platform should be erected, and placed horizontally, with its surface level, and its edge immediately in contact with the bottom of the picture meant to be transferred. The use of this platform is for the above described bearer to move and rest upon; which bearer should be set on its end, with one edge in contact with the wall, at one side of the picture; consequently the other edge will be at some distance from the wall, according to the size of the picture and convexity of the bearer. Being thus placed, the superfluous edge of the securing canvass should be turned over, and nailed to that edge of the bearer that is next the wall: this done, the operation of cutting away the plastering should be begun, which may be done with the corner and end of a short saw, by sawing between the brickwork and plastering, leaving the thickness or part of the thickness of the plastering on to the painting, fastened to the bearer; and when this edge of the picture is freed, the whole height, of nine or ten inches, under the edge of the bearer that is furthest from the wall must then be gently forced nearer; consequently the other edge, together with the painting and plaster that is freed, will leave the wall, and give an opportunity of introducing a saw behind, and cutting away the same to a certain distance further under; and by repeating

thus, the whole of the picture will at last be freed, and left on the bearer each time the bearer is removed, and, as it were, rolled on the vertical surface of the wall, care must be taken to turn and nail the securing canvass on the top and bottom edges of the bearer, so as to secure the freed plastering and picture from moving about, and lastly, before the bearing and painting be moved, to nail the other edge of the picture in the same way, which will secure the whole to the bearer. This done, the picture and bearer are at liberty to be moved to a proper place, in order to be freed from the remaining plaster, the edges may then be unnailled, and the painting and canvass slipped from this bearer on to a plain board, and the new canvass then put on, and remain till dry, as in other cases.

It may appear that the bending of the canvass and plastering to the convex bearer will crack the plaster, and damage the painting, but from experience I have observed that to a curve of such, or even less radius, plastering will bend without any visible crack even on the exterior part thereof, and that part next the bearer, not having occasion in bending to extend its parts, will consequently be much less liable to be disturbed by such bending.

ON THE COLOR OF FLAME

THE color of the light that is extricated in a flame depends, 1st, on the mode of combustion; or, 2nd, on the presence of some foreign body or extraneous ingredient. 1. When alcohol or rectified spirit, having a specific gravity of about 835, is burned in a lamp without a wick, and with a half inch flame, or when it is burned on a flat surface of glass, the flame is altogether of a blue color. Again, when in burning the same fluid with the glass burner, the flame is enlarged to an inch, or an inch and a half in length, a considerable quantity of white light is extricated. Lastly, When the extremity of the glass burner is brought to a red heat, or thereabouts, by holding it in the edge of a blue spirit flame, portions of the alcohol are successively exploded as they come into contact with the heated extremity of the burner, and then much yellow light is extricated. We have thus blue, white, and yellow light extricated during the combustion of the same fluid, and depending wholly on the mode of combustion.

Oil may also be burned so as to give out either a blue, a blue and white, or a blue and yellow flame. When oil is burned in a lamp without a wick, so as to give a large flame, the light extricated is blue, with a great proportion of white. But if the stop-cock be cautiously turned, the white light diminishes, and at length there is only a blue flame. By again increasing the flow of oil, a spot of yellow light appears in the centre of the blue, and by still farther increasing the supply, the white, that is the usual yellowish white, flame re-appears. On the same principle, a wine glass full of oil may be made to exhibit either a blue flame, covering the whole surface of the oil, or a flame of a blue and white color.

When diluted alcohol, commonly termed ardent or proof spirit, is burned in a lamp *without a wick*, the color of the flame is blue, or blue and white, similar to the flame of alcohol formerly described. In this case, a simple distillation and combustion goes forward, the whole of the water being separated as cold or nearly as cold, as before its passage through the flame, and the burner only acquires a perceptible increase of temperature. The flame has

a fine conical form, and the combustion proceeds without any buzzing noise.

When diluted alcohol is burned *with a wick*, the flame is not blue and white, as when a slow conducting tubular burner is made use of, on the contrary, much yellow light is given out, the white disappears, and a portion at the base has a blue color. The form of the flame is much less regular, it has a disagreeable flickering motion, and the combustion is accompanied by a constant whirring or buzzing noise.

It would appear that, though some attention has been paid to the noting of such substances as give out particular kinds of colored light when subjected to a high temperature, or when dissolved in the fluid which supports combustion, but little attention has hitherto been paid to the colored light of a flame, with the view of ascertaining the mode of its production. That this and the other substances give a yellow or green flame, and that the quantity of yellow light may be increased by particular means, has been ascertained, but on what the extrication of yellow light depends, or what particular process goes forward during its production, remains to be investigated. The following short extracts from a publication of modern date, and by a gentleman distinguished in the ranks of science, will be found interesting—"After numerous experiments, attended with much trouble and disappointment, I found that almost all bodies in which the combustion was imperfect, such as paper, linen, cotton, &c. gave a light in which the homogeneous yellow rays predominated, that the quantity of yellow light increased with the humidity of these bodies, and that a great proportion of the same light was generated, when various flames were urged mechanically by a blow-pipe or a pair of bellows. As the yellow rays seemed to be the product of imperfect combustion, I conceived that alcohol, diluted with water, would produce them in greater abundance than when it was in a state of purity, and, upon making the experiment, I found it succeed beyond my most sanguine expectations."—"I found that the discharge of yellow light depended greatly on the nature of the wick, and on the rapidity with which the fluid was converted into vapor. A piece of sponge having a rough surface, was found to constitute the best wick, and for converting the alcohol rapidly into vapor, the heat of the wick-holder was increased by a spirit lamp, or red hot wire gauze was brought into contact with the surface of the sponge."—*Dr Brewster, in Trans R.S. Edin*

By these extracts, we are given to understand, that, when alcohol, "in its purity," is burned, it gives a yellow flame, but that, when alcohol, diluted with water, is burned, yellow light is given out in greater abundance, and the conclusion seems to be, that as moisture increases the quantity of yellow light during the combustion of cotton, paper, &c. so water added to alcohol has the same effect, and that, on such occasions, the water acts by causing, or by increasing the disposition to "imperfect combustion." Admitting, however, that these views were established, such questions as the following immediately present themselves. What is imperfect combustion? Is the presence of water essential or only accessory? &c. This is a subject that might engage the attention of some one of the many expert chemists of the present day. There is certainly no want of interest, and much precise information is still wanting.

(To be continued.)

SUBSTITUTE FOR GLASS PAPER.

BY MR. LARKIN.

MR. LARKIN, in finishing his beautiful models of crystals, made of wood, employed a flat wooden wheel mounted upon the end of his lathe-mandrel, and covered with glass-paper. This, however, soon wore out, and required continued renewal. He then thought of coating the face of his wheel with calcined flint, reduced to powder, and sifted into different sized grains, according to the degree of fineness, or coarseness, he wished to give his wheels. These particles of flint he glued upon the faces of his wheels, and found them to answer his purpose most completely, they lasting much longer than the glass-paper ever did.

We can readily account for this much greater durability of the flint than the glass, by considering that the particles of glass, however much divided, still possess *smooth polished surfaces*, which afford no hold for the glue, which affixes them upon the surface of the paper. Whereas the particles of flint, viewed in the microscope, exhibit numerous *asperities*, or *roughnesses*, which consequently admit of the glue retaining them much more firmly. Neither are the particles of flint so brittle as those of glass, and this again gives them a much greater degree of durability in use. It might be well to manufacture *flint-paper*, in addition to the numerous varieties of glass, emery, sand, and other papers.

We presume it will hardly be necessary to recommend to the piano-forte makers, and other workmen in wood, the covering of their wheels with *powdered flint* glued at once upon them, instead of the glass-paper hitherto used by them.

GALVANIC PROTECTION TO THE COPPER SHEATHING OF VESSELS.

It was generally believed that sea-water had but very little action upon pure and well-rolled copper, and that its occasional rapid corrosion depended upon some impurity of the metal, or some imperfection in its manufacture. It was found, however, on immersing pieces of the best and purest copper that could be procured, in sea-water, that it soon became covered with a green powder, and was ultimately more or less oxidized and corroded. It was evident that this action depended upon the mutual attraction of the *positive* copper and the *negative* oxygen or acid contained in the water, and that it might, therefore, possibly be suspended or prevented, by communicating a *native energy to the copper*, which would cause it to *repel* its assailants; and this was easily effected, as the previously detailed experiments teach us, by attaching to it any more oxidable metal, such as zinc, iron or tin.

In experiments upon the small scale, it was found that a piece of *unprotected* copper, immersed in a glass of sea-water, was soon covered by a green powder, part of which was dissolved, and part precipitated; but on attaching to it a piece of zinc, and keeping the metal, thus *protected*, under sea-water, it remained bright, and even untarnished, for several weeks: of the facility, therefore, of thus effectually protecting the copper, there could be no doubt: but a point of great importance in reference to the present question was to determine the relative proportion which it was necessary for the *protecting* metal to bear to the *protected*. When the former was zinc or iron, and amounted to from one-fortieth to one-hundred-and-fiftieth of the copper surface, the latter metal underwent no change or decay; when

the zinc was reduced to one two-hundredth, and one four-hundredth, there was some perceptible loss; but it is, to a considerable extent, effectual, where it only amounts to one one-thousandth. For these purposes cast-iron answers extremely well, and is cheaper and more durable than zinc; for it will be remembered, that the protecting metal is acted upon with a rapidity directly proportional to its saving power.

As far, therefore, as *protection*, or prevention of decay is concerned, the above experiments are extremely satisfactory in their results, and seemed, at first sight, to hold out well-founded hopes of their being applicable upon a large scale; but it unfortunately happens that, when a negative electric power is thus conferred upon the copper, so as to protect it from oxidizing and corroding agencies, it becomes, as above explained, attractive of metals and of their oxides, and, in short, of the whole list of cations or electropositive bodies: among these are the *earthy substances* contained in sea-water, such as lime, magnesia, and some of their compounds: these, therefore, when the plan was adopted upon a large scale, and a protected vessel sent to sea, were precipitated or deposited upon the copper. Now it seemed, at first, as if this earthy coating would merely act as an additional preservative of the copper; but, unfortunately, the adventitious crust or surface thus formed, is most favorable to the adhesion of weeds, and of certain marine animals; and these accordingly attached themselves to it so rapidly, and in such abundance, as to render the bottom extremely foul, and to interfere with and impede the sailing of the vessel. Theory would lead us to expect, that the zinc or iron might be so exactly proportioned to the surface of the copper, as effectually to protect it, without at the same time communicating to it that tendency to attract an earthy crust, which has just been mentioned; but in practice this has been found scarcely attainable.

BROWNING GUN-BARRELS.

In our first volume, p. 168, we gave an account of various methods of performing this process. In the ninth volume of the *American Journal of Science and Arts*, we found the following particulars, communicated to the Editor of that work by Mr. John Duntze, of New Haven, and which it may be desirable to add to our former account.

The browning mixture.—This is composed of the following ingredients, viz:—Nitric acid, 1 oz; sweet spirits of nitre, 1 oz; spirit of wine, 2 oz; blue vitriol, 4 oz; and tincture of steel, 2 oz. These ingredients are to be mixed, the vitriol having been previously dissolved in a sufficient quantity of water to make, with the other ingredients, two quarts of the mixture.

Previously to commencing the operation of browning a gun-barrel, it is necessary that it be well cleaned from all greasiness and other impurities, and that a plug of wood be put into the muzzle, and the vent be well stopped up. The mixture is then to be applied with a clean sponge, or piece of rag, taking care that every part of the barrel be covered with the mixture; it must then be exposed to the air for twenty-four hours, after which the barrel must be rubbed with a hard brush, to remove the oxide from the surface. This operation must be performed a second, and, if necessary, even a third time, by which the barrel will be made of a perfectly brown color. It must then be carefully

brushed and wiped, and immersed in boiling water, in which a quantity of alkaline matter has been put, in order that the further action of the acids upon the barrel may be prevented, and the impregnation of the water by the acids be neutralized. The barrel being taken out of the water, must, when rendered perfectly dry, be rubbed smooth with a burnisher made of hard-wood: it must then be heated to about the temperature of boiling water, and will then be ready to receive a coating of a defensive varnish, made of the following materials:—Spirit of wine, 1 quart; dragon's blood, (*sanguis draconis*.) pulverized, 3 drams; shell-lac, bruised, 1 oz; mixed and dissolved by a gentle heat, and then strained for use. After the varnish is become perfectly dry upon the barrel, it must be rubbed with the burnisher, to give it a smooth and glossy appearance. Thus far the American account. We think it proper to add, that the use of sulphate of iron, (green vitriol), has become frequent amongst the London gun-makers, as well as that of the sulphate of copper, for producing a prominent *veining* on the surfaces of the barrels, and which is now become desirable in imitation of the Damascus barrels.

SCHOOLS OF ART.

(Resumed from page 72, and concluded.)

The French School is not very easily characterised, taking it *en masse*; since its elements are various, and it comprises within itself several wholly different styles. Of those artists who may be ranked among its ornaments, some have cultivated the Florentine, some the Roman, some the Venetian manner, whilst others, with a becoming ambition, have trusted to nature and their own genius.

France possessed at a very early period the art of painting on glass, as well as that of miniature: and in both these departments Italy herself stands under obligations to the *grande nation*. The oldest of the French painters, however, who left a reputation behind him was Jean Cousin, who, although chiefly devoted to paintings on glass, yet exercised his talents upon canvass also. He likewise practised sculpture. He was correct but inelegant in his drawing. The three greatest names in French art are Claude Lorraine, Nicholas Poussin, and Anthony Watteau, and the latter alone can fairly be classed in the French school, as the two former practised in Italy, where their style was altogether formed. Of Watteau it is difficult to speak too highly. He appears to have been one of the most delightful artists that ever set brush to canvass. He is the painter of refined life in its hours of repose and enjoyment. His figures are all true gentle-folks without the slightest parade or affectation. His fancy seems to have dwelt eternally among those scenes which embellish and throw a grace over existence. A ball or concert under the umbrageous trees, or a lady singing while her cavalier, stretched at her feet, accompanies her on some musical instrument, are the subjects he loves to illustrate. Watteau's landscapes are not good; indeed, his spirit seems to have been so well tuned, that he required nothing more than a green turf and a few trees to become moved to elegant mirthfulness. A house (generally of handsome dimensions) is commonly introduced in the background, to indicate that a few minutes would suffice to put the ladies beneath its comfortable roof, if the dew fell, or an overhanging cloud discharged its moisture; and, on the whole, the spectator feels that

quiet happy sensation almost always excited by the contemplation of "becoming mirth."

It now remains that we take a brief notion of the school of painting which has sprung up in our own country. This, like the French school, is not easily to be specified. Its range is extensive, but it may be said to shine with the greatest effect in the walk of portrait. Millin, who seems to take every opportunity of doing us justice, gives the English school of artists praise for "judicious composition, great excellence in drawing the human form, elevated ideas, and truth of expression. Several masters of this school," he goes on to observe, "unite the fine coloring to the more exalted parts of the art, and it may be remarked that their colors, less brilliant than those of the Flemings or Venetians, resemble greatly those of the Lombard school." At the head of the English school of painting may be placed the names of Hogarth, Reynolds, and Wilson; and the impetus given by them to the art has since produced a number of worthy successors. At the present day, we are happy to say that the historical department is cultivated with a greater chance of success than ever.

We shall now proceed to extract a few passages from the "Epochs of the Arts," by Mr. Hoare, from which the reader will gather a more complete view of the recent, and indeed present state of British art than from any other source with which we are acquainted.

"The annual returns of numerous exhibitions of painting in different parts of the kingdom, though they may occasionally be without some particular specimens of superior talents, unquestionably demonstrate the average state of the arts amongst us;—that average state which, it has been asserted, must correspond, in a very great measure, with the general state of the public feeling with regard to the arts. Let us first look at the exhibition at the National Gallery: what does it exhibit? A splendid mass of portraiture, such as has rarely, if ever, been surpassed in any school of any nation. To this point, the actual degree of knowledge and esteem of painting in the public, and the skill of the artist, equally concur. The slowly awakening taste of the nation has scarcely produced any increase of works in the higher classes of art. In familiar history, the scenery of humble and domestic life, the nearest allied to portrait painting, extraordinary efforts have deservedly attracted a considerable portion of public attention. The number of historical pictures in other classes continues in the same inferior proportion as ever, to that of portraits. The nation views with complacency, and without farther ambition, an excellence of no inconsiderable degree, widely diffused in the latter branch; and its taste may be regarded as so far advanced, as it no longer imagines superior powers to exist in every work of foreign schools.

"Our exhibitions of water-colored drawings have displayed a uniformity of merit in landscape; and some examples have here also appeared in subjects of familiar history, which added, perhaps, by the comparatively easy method of execution, have presented instances of graphic expression, seldom seen except in works of the highest kind. To this point also, the state of the art appears to be within the compass of the actual degree of public knowledge.

"The British Institution, having provided commodious rooms where the pictures of living artists might be exhibited, has annually admitted for sale whatever works of competent merit have been sent

thither. It assembles, also, an annual collection of the works of Italian and other masters, which students are invited to copy: a judicious and liberal arrangement, tending to relieve one of the greatest deficiencies noted in the Royal Academy, and acceptable to the young proficients, in proportion to the exceeding difficulty of procuring access (for the purposes of study) to many valuable collections with which the metropolis abounds. Not long after its establishment, it announced the offer of pecuniary rewards for the best compositions in distinct classes; and in proportion as its funds increased, it has augmented its rewards. It commenced also its gallery of ancient masters. Finally, redeeming the neglect of the age, and offering to the state an example of patronage, the directors purchased of a great historical painter one of his best and latest works, at the splendid price of 3,000 guineas, purposing at the same time that it shall form the commencement of a gallery of the *English school*. After the long interval, which had succeeded to the labors of Barry, at the Society of Arts, this purchase made by the British Institution is to be hailed as the first example of public patronage shown to painting in England.

"The institution will ever merit the gratitude of English artists for the weight it has added to the benevolent efforts of individuals in favor of our native school. It has opened the doors of opulence to the admission of English pictures, and reconciled the patrons of foreign talents to the pretensions of our own. Nor is it a matter of small moment, that, if ever the government should assume to itself the patronage of the higher provinces of painting, its views would be found so fully seconded by the British Institution, as to produce nearly a complete arrangement of the powers of the state in regard to painting. This respectable institution, even if it should not attain a higher end, cannot fail to create a body of artists, capable of filling every subordinate channel with adequate excellence.

"The exhibitions established in the provincial cities have been in many instances highly creditable to individual exertion, and may not a little tend to mature the taste of the public; but they have been hitherto attended with very various results. In some instances they have been greatly successful; in others far less prosperous.—Little information is to be gathered from them respecting the present state of the public knowledge or taste."

In most of the schools of art we may trace some predisposing cause for the peculiarity of style and genius by which they are characterised. Thus the Roman school deduced its manner from the admirable education afforded to its earliest practisers and to the *chefs-d'œuvre* of ancient art found among the ruinous parts of the "eternal city." With respect to the Venetian school, the magnificence which was imparted to Venice by commerce with the East, together with their frequent fêtes and masquerades, and the splendid vestments of their nobles, produced that richness and warmth of color by which its works are distinguished: while the Dutch school, on the contrary, owes to the humble and unpretending life of its artists, who were ordinarily the frequenters of taverns and workshops, that lowliness of style and want of selection as to subject, which require all the transcendent talent for correctness and spirit possessed by its followers to lift it above reprobation.

COLOR OF FLOWERS.

DECAUDOLLE devotes a chapter of his "*Physiologie Végétale*" to the subject of vegetable colors; in which he embodies almost all that has been either ascertained or conjectured concerning their cause.

It consists of four sections,—1, organs exhibiting no color. 2, organs exhibiting a green color. 3, organs exhibiting or changing to any color but green. 4, fugacity of vegetable colors.

1. The color of plants seems, at first sight, as if it were inherent in their whole mass; but a more accurate inspection shows it is proper only to certain parts. The membranous tissue of the plant, whether cellular or vascular, is uniformly colorless. It is the contained juices only that acquire color;—a property which they owe to the action of the light of the sun. This is proved by the phenomena of etiolation and of blanching;—the result of vegetation in obscurity, and a fact known to almost every body. If a potatoe happens to throw out shoots while it lies in a dark cellar, they come up pale, weak, and watery. If the leaves of celery, or of lettuce, are excluded from the action of the light of day, they become blanched. Guettard regarded etiolation as the effect of suppressed evaporation. Decandolle does not think the cause assigned sufficient to account for the fact. It is to the want of light and not to the want of evaporation that the plant owes its paleness. Some plants, whose leaves do usually assume a specific color, exhibit parts or patches altogether colorless. Such are the leaves called variegated. The phytologist regards them as indications of disease; the gardener, or the amateur, as an ornament. Decandolle regards them as parts where the chromule, or contained colorable juice, is deficient, either in its due quantity or quality.

11. All organs exhibiting or assuming a green color are found to be capable of decomposing the carbonic acid of the sap or of the air, when exposed to the action of solar light. In this operation the oxygen of the acid is exhaled into the atmosphere, and its carbon fixed in the vegetable tissue. Whence it seems to follow that the green color of the leaves is owing to the fixation of carbon; for where the decomposition of carbonic acid is not going on the organ remains colorless. The brightness of the green seems to depend upon the degree of light to which the organ is exposed; and yet solar light is not indispensable. Decandolle gave the green color to some plants of *Lepidium sativum* merely by the light of a few Argand's lamps; but they did not give out oxygen when placed in water.

Still the deposition of carbon caused by the action of solar light does not affect the membranous tissue. Still this tissue retains its original color and transparency, so that it is only the encyema or chromule of Decandolle which assumes the green color. But how does carbon which is black, yield a color which is green? Senebier solved the problem as follows:—Carbon is, in strict propriety of speech, not a black, but a very deep blue; and vegetable tissue is not absolute a pure white, but rather a pale yellow. Hence, the green is formed by the mixture of a yellow and blue. This explication *quoique un peu mécanique*, Decandolle regards as likely to be the true one. Yet we cannot help entertaining some doubts with regard to its validity. Surely the membranous tissue of many plants assuming a green color has nothing in it of a yellow. But wherever we turn to look for an explication there is doubt: and the solution of the problem may be

said to be a chemical puzzle. One attributes it to the presence of an oxide of iron; another to the predominance of an alkali, and neither solution is satisfactory. Yet plants placed in the dark do not lose their green color, if the atmosphere in which they grow contains a certain quantity of hydrogen or of azote. Humboldt found the leaves of *Poa annua* and *Plantago lanceolata* still green though growing in the galleries of the mines of Freyberg. It should be recollected, however, that they must have been occasionally exposed to the light of the miners' lamps. Leaves, bractes, calyxes, ovaries, are the organs that are most generally green: though you may find exceptions to the rule, both in organs which it includes and in organs which it excludes. The bractes of *Bartsia coccinea* are scarlet, and the embryo of the mistletoe is green.

III. Though leaves in a healthy state assume for the most part a green color, yet they do not always retain that color so long as they may be said to live. In the autumn they change to yellow, with the exception of the leaves of evergreens, which retain their green color till the spring. M. Macaire regards this change of color as originating in a higher degree of oxidation, owing to the diminished exhalation of oxygen gas in the day, and its increased absorption in the night. The first degree gives yellow; a second degree gives red. This explanation Decandolle seems willing to receive, believing that the *chromule* of the cells is thus capable of assuming all manner of tints, especially if aided by the presence of acids or alkalies.

Changes similar to those resulting from age may occur merely from accident, as from the puncture of insects, the growth of parasitic fungi, or the blighting influence of frost. First they change to yellow; then they change to red.

But some leaves present naturally a different color on each surface. The upper surface of the leaf of the cyclamen is green; the under surface is red: yet the red *chromule*, in this case, exhibits the same chemical properties as the *chromule* that has been changed to red as the result of age.

What has been said of leaves with regard to color may be said of flowers also,—particularly upon the presumption that flowers are nothing more than a mere modification of leaves. It follows, therefore irresistibly, that all varieties of color in flowers or their parts, are owing to the different degrees of the oxidation of their *chromule*, except in special cases determined by the presence of acids, or of alkalies in a free state.

M. Decandolle refers to a *memoire* of M. M. Schubler and Funk on the colors of flowers, which they divide into two grand series corresponding to the two grand types of vegetable color—yellow passing into red and white, but never into blue; and blue passing into red and white, but never into yellow. The former they call oxidated colors—the latter de-oxidated colors.—Green being the point of equilibrium between the two series. In the process of oxidation you have yellow-green, yellow, orange-yellow, orange, orange-red, red. In the process of de-oxidation you have green-blue, blue, violet-blue, violet, violet-red, red. To avoid the hypothesis of oxidation and de-oxidation, Decandolle denominates the two series the *xanthique* and *cyanique*, indicative merely of the blue and yellow types. In the *xanthic* series we find cactus, mesembryanthemum, aloe, cyrtus, oxalis, rosa, verbas-

cum, &c., &c. In the *cyanic* series we find campanula, phlox, vinea, hyacinthus, &c., &c.

White is excluded from either series, because it is thought to be doubtful whether it exists naturally in a pure state among vegetables. We do not see the ground of all this distrust. Why is not white to be called white? Surely the corolla of *Lilium candidum* is a very good example of the color in question. The following changes of color in quick succession are worthy of notice. The flower of *Hibiscus mutabilis* bursts open its integuments in the morning. Its corolla is then white; at mid-day it is flesh-colored; at sun-set it is red.

Black is also excluded with more apparent propriety, and yet it is to be found in the petals of some few flowers. *Pelargonium tricolor* and *Vicia Faba* will furnish examples.

The infusion of vegetable reds in alcohol takes a deeper tinge by the addition of an acid, but gives no uniform result by the addition of an alkali. The infusion of vegetable yellows is discolored by the addition of an acid, but rendered more intense by the addition of an alkali. The infusion of vegetable blues is rendered red by the addition of alkalies—furnishing the well-known chemical test.

From what has been said, it follows, according to Decandolle, that the modifications of the *chromule*, occasioned by the degree of its oxidation, are the cause of the diversity of colors in the appendages of plants at least—that is, in the leaves, or modifications of leaves, whether spathe, bractes, calyx, or corolla. The degree of oxidation proper to leaves produces green; a higher degree leads to yellow and red; a lower degree to blue.

IV. The brilliancy of the coloring of vegetables, lovely though it be, soon begins to fade, by disease, or by accident, or by death; and plants are often stripped of their colors by the operation of the same agents through which they originally acquired them. The action of solar light, when too intense, destroys the very color which it had but just generated. Hence the experienced florist places his gaudy but delicate tulips under shelter, knowing that the direct action of the sun's rays would speedily impair their beauty.

The color of the greater part of the aquatics undergoes a decided change at their death. The *Fuci* in particular, when exposed to the action of the atmosphere, pass from a fine red, or from a fine green, to a dull and dirty white. The characeæ undergo a similar change, owing, as Decandolle thinks, to some change in the composition of their *chromule*, or to the great quantity of calcareous matter incorporated in their tissue. Leaves in dying assume, for the most part, that brown or russet color known by the name of *feuille morte*. It is owing to a change in the composition of their primary principles, accompanied with loss of water. The same explication applies to fruits. The bark of trees in decay changes to a grey, or russet, or dingy white, occasioned by the joint operation of light, of oxygen, and loss of moisture; and even the indurated wood composing the interior of the stem, when cut up and exposed to the action of the sun and air, shrinks, and changes to a deeper shade, which it owes to the operation of the same causes.

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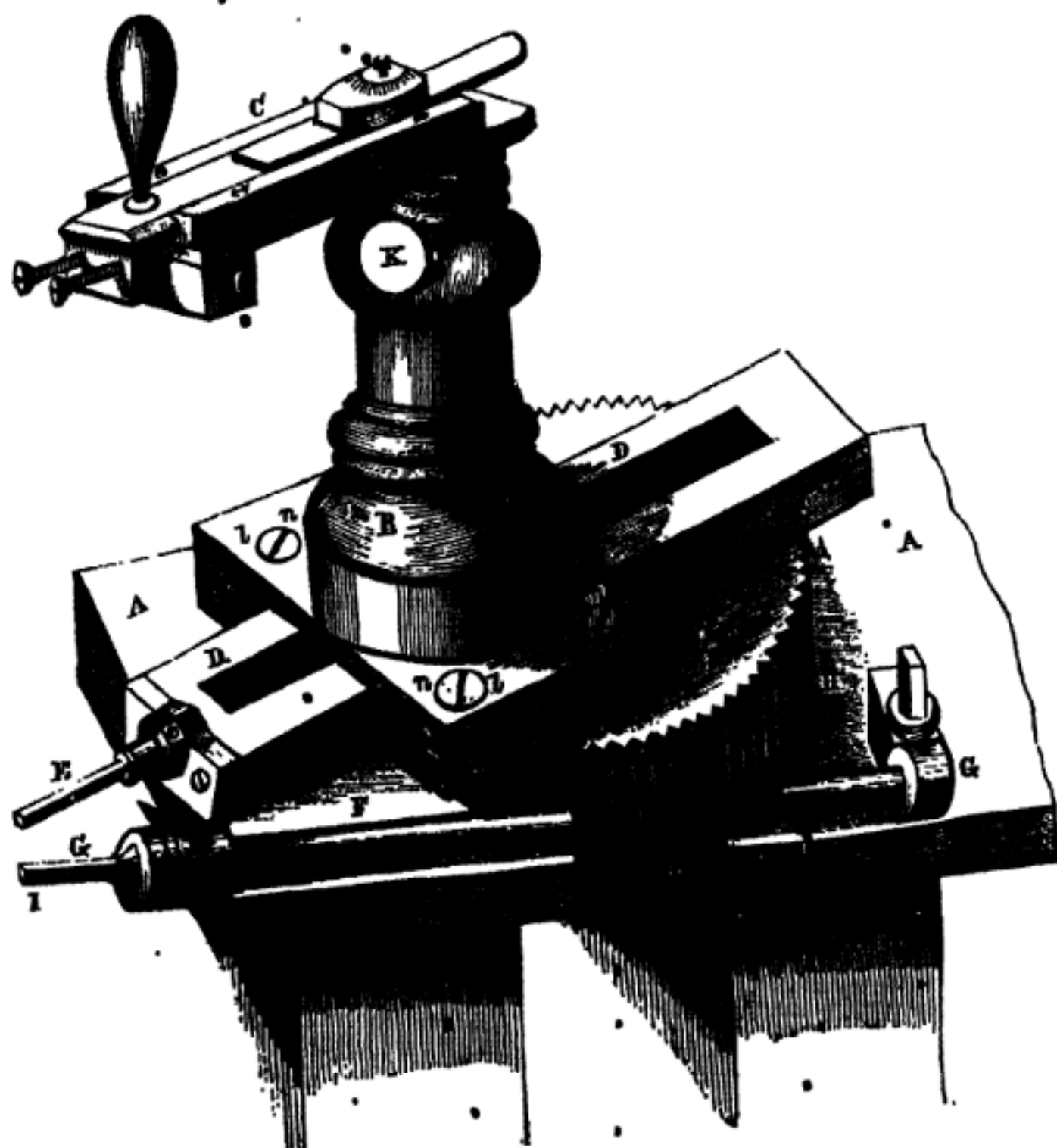
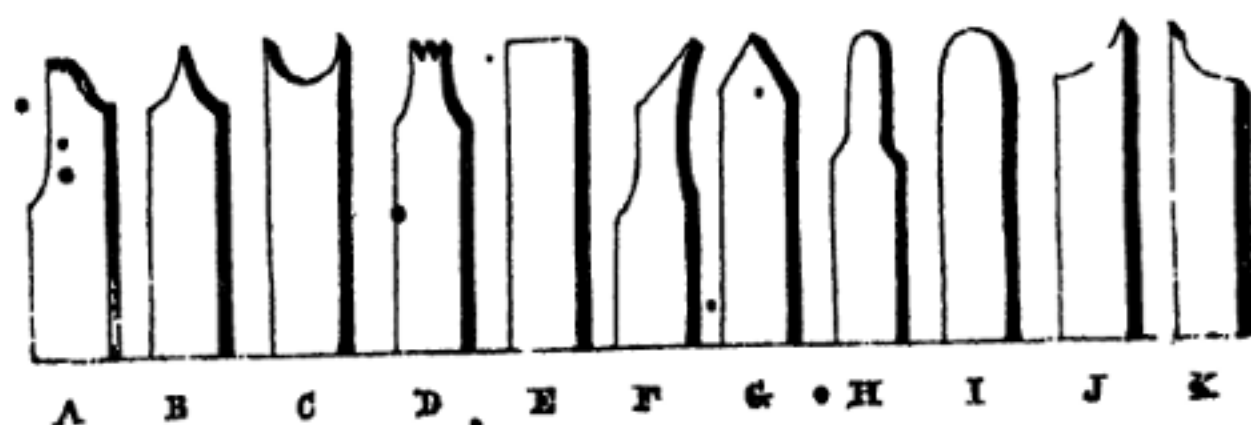
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THE
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And School of Arts.

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THE CIRCULAR SLIDE REST AND ITS TOOLS.

The Handbook of Turning: containing Instructions in Concentric, Elliptic, and Eccentric Turning. Also, various Plates of Chucks, Tools, and Instruments: and Instructions for using the Eccentric Cutter, Drill, Vertical Cutter, and Circular Rest, with Patterns and Instructions for working them. 143 pages. Saunders and Otley.

We have often regretted that there should be so few books published on the mechanical arts in England. No English work is to be found on the making of organs and other musical instruments,—none on the manufacture of philosophical instruments; but one on wheel-carriages, and that not practical; nothing really useful on the numerous mechanical trades we practice daily, especially not one general book on *turning*, although an art multifarious, useful and ornamental, and one which besides affords so constant and varied a source of amusement to thousands of amateurs. Ibbotson's "Geometric Turning," the only work we have upon the subject, is very dear, and confined entirely to an account of his own chuck, and even that he has certainly not made the most of. The regret that so favorite an art should be so much neglected, confirmed as it is by numerous correspondents, has led us to procure the "*Handbook of Turning*," and of which a tolerable full account is given in the title-page, forming the head of this article.

The work itself is more comprehensive than the price would induce us to expect, and may be recommended to the amateur, who is not already far advanced in the art; still the book is not that desideratum which was wanted. It does not go far enough into the subjects, and gives no account of the more complex chucks, and of the very superior work executed by them; so also of the segment engines, rose engines, of Cheveton's busts, of scroll turning, and of the more difficult parts of the art, it is silent. Relative also to the turning of those objects which involve peculiar care, and consequently require especial instruction, and which it treats of,—the information given is not sufficient; for example, to turn the Chinese-balls, which are so much admired for their beauty and curious workmanship, we are told to proceed as follows:—"As they are composed of spheres one within the other, the holes must be just deep enough to leave the thickness between each little more than the diameter of the smaller sphere. The work must be begun by forming the innermost sphere, and afterwards it must be continued regularly on to the larger, till at last the outer sphere is completed." Nor is the information at all times to be depended upon; for example, the receipt for dyeing ivory of a black color is thus given. "Boil a quarter of a pound of logwood shavings in a quart of water in an earthen vessel for half an hour, steep the ivory in it." This will, as is evident, stain it of a purplish red, and not a black, unless a salt of iron be added to it. Added to this the type is large, consequently there is but little in a page, and the perspective of the plates very bad.

With these defects, it may be a matter of surprise why we should recommend the work. It is because the would-be turner has not a better: and from the very numerous patterns given, and many tools and instruments described, it will be to the adept very useful. As to the formation of eccentric patterns or flat surfaces, and illustrations of which we gave numerous examples of in our second volume, the "*Handbook of Turning*" equals, if not excels, the guinea work of Ibbotson, and will be found highly

useful. A second source of value is that the work gives an account of most of the ordinary tools and apparatus used in turning, with the application of each, interspersed with practical remarks. As we have given extracts of what we have considered defects, it will be but just that we should allow the author an opportunity of showing himself in the description of an apparatus, and for that purpose we choose the circular slide rest, with the cut illustrative of it; also, as we neglected when before treating of the slide rest, to figure the tools generally used with it, we have added the most useful of them, observing that only a part of these tools are given in the "*Handbook*." The use of each particular tool will suggest itself to the turner, each forming a channel or a moulding the contrary to itself. On the circular slide rest the author writes as follows: and as the following occupies two pages of his work, the extent of the whole may be easily ascertained.

The Circular Rest.—"The rest called the *Parallel Rest*, works, as its name sufficiently expresses, in a straight line; it is therefore useless for ornamenting spherical objects, and the circular rest has lately been invented to supply this deficiency. It is a most ingenious contrivance, and perfectly fulfils the purpose for which it was invented.

"The bed A A, is the same as in the parallel rest, and screws in the same way to the bed of the lathe. B is a brass socket and pillar, which support the bed C, in which the tool box slides; they are formed in the same piece with the lower bed L L, and firmly fixed into the lower part, which is grooved, by four brass-headed screws, n n. The grooves enable the whole socket and tool box to slide backwards and forwards on the bed of steel, D D, and by means of the screw which passes through it, the workman regulates the advance or retreat of the rest to or from the work in a *straight line*, while the lower part remains stationary. The small wheel E, is graduated, and turned by a key to enable the turner to count the distance. F is a steel spindle, which works in two brass collars, G G; about half way down, the spindle is formed into a screw O, which turns upon the brass wheel H, and by moving the nut J, moves the whole rest in a circular direction, in the same way that the screw in the steel bed D D, impels it in a straight line; by this ingenious contrivance all objects that are round or spherical can be ornamented; such as balls, the globular sides of vases, or small baskets, in every variety of pattern. The learner will easily discover the proper method of using this rest, which is very simple in its mechanism and use. The nut K, is for setting the tool slider at different angles, the same as in the parallel or sliding rest; the tools to be employed are those of the above-mentioned rest."

IMPRESSIONS OF LEAVES, &c.

(To the Editor.)

SIR.—Having observed in your Magazine, to which I am a constant subscriber, methods of taking the impressions of the leaves of plants, I take the liberty of sending you the inclosed specimens, and the following method of taking them, not only from leaves but *branches*; both *back* and *front* at the same time.

Take your sheets of paper and make them damp with a wet sponge, and lay them between sheets of blotting or other paper under a weight till you are ready to use them. Procure from the printer's a little letter-press ink—rub it out on a smooth slate—get a piece of parchment and soak it in water till it is

thoroughly saturated,—then squeeze the water from it so that it will be soft and damp, but not wet,—tie it up with wool inside as a substitute for a printer's ball,—dab it about the slate till the ink is evenly distributed, lay the back of your leaf on the inked slate, and carefully bend its upper surface; when the leaf or branch is thus prepared, lay it on a blanket or quire of smooth paper, place your branches or leaves on one side of the sheet, and turn the other over upon them, then take a silk handkerchief and go over them with a light and even pressure; you will thus have a complete fac-simile of each side of the leaf.

If you think the above worth a place in your valuable Magazine, you will oblige yours, &c.,

15, Holford Street, Cheltenham. H. RUSSELL.

P.S.—By the above method I have taken from 150 to 200 impressions per hour, and in the same way a fern, three feet seven inches in length.

ON THE COLOR OF FLAME.

(Resumed from page 76, and concluded.)

THE blue flame of diluted alcohol has a regular form; is steady as that of a well-adjusted candle, and the combustion proceeds in silence; but, when burned with a wick, or otherwise, so as to give a yellow light, the flame is very unsteady, and the combustion is always accompanied with noise. Whether this noise proceeds, in every instance, from actual explosions, may be uncertain; but it is certain that when diluted alcohol is exploded, by throwing it into a red hot fire, or by other means, a profusion of yellow light is extracted; and, when it is burned with a wick, there is a constant buzzing noise, with an appearance as if this noise was produced by an infinity of minute explosions, at that part of the flame where the narrow blue line appears. It is particularly to be observed, however, that this part of the flame remains unchanged, and that it is the exterior brush flame that is changed from a pale misty-blue to a yellow color. The blue flame of alcoholic fluids may be made to swell out or expand, by touching the fluid as it issues from the burner, with a hot wire, and without in any degree altering the color of the flame; and, in this case, there is simply an increase of the distillation. But, with the same wire, or with a rod of glass, the mouth of the burner may be so touched as to produce a discharge of small particles of the fluid, similar to that which takes place on other occasions, when a very hot piece of metal is introduced into a vessel containing water. These minute particles are impelled against the inner surface of the flame, seem to explode, and then produce the dull-yellow color of the exterior brush flame. When a wick of cotton, or of sponge, is used, it acts the part of a hot wire; and the rougher its surface, and the nearer it approaches to the inner surface of the flame, without being carbonized, the more violent is the discharge of the particles, and consequently of the yellow light. This may be farther illustrated as follows:—Let a small ball of cotton be attached to the end of a glass tube, and moisten the ball with alcohol. When the latter is set to burn, yellow light is extricated; but if the ball be now made to turn rapidly on its own centre, a large quantity of yellow light will be increased a hundred-fold. In this case, two causes operate; the flame is brought closer to the ball, producing a larger discharge of minute particles; and, at the same time, the alcohol is expelled by the rotatory motion in a thick shower into flame.

Steam issuing forcibly from a small orifice will answer the purpose of a blow-pipe; and, even when it is condensed into a white vapor, it has no effect in changing the blue color of a spirit-flame. But if a small vessel of water be placed under the burner and a hot rod of metal be introduced, so as to discharge particles of the water on the exterior surface of the flame, yellow light is extricated. Some of the colored light is in this case, apparently produced by small solid particles from the surface of the metal, bright sparks being observed; but rods of different metals produce similar effects; and when numerous minute particles of cold or boiling water are made, by mechanical means, to impinge on the exterior surface of the flame, the blue color is not thereby affected. A perfectly clean rod of glass, however, has the same effect as rods of metal, only no sparks are observed; and hence particles of the water of wells, thus elicited, cause the extrication of yellow light; but pure water, that is, the pure compound of hydrogen and oxygen, has not been procured for experiment. When the particles of alcoholic fluids, or of water, impinge on the interior or exterior surface of the flame, there is doubtless an absorption of heat; but the mere absorption of heat cannot produce the observed defects, as appears by an experiment already noticed. If we approach a blue spirit flame to another of the same color, no change is produced: but, if a flame of that color be brought near to a yellow spirit flame, so that the gaseous products of the latter may come into contact with the former, the blue flame acquires a yellow color. Hence the products or substances emitted from a yellow flame are different from those of a blue flame; and as steam, as formerly stated, does not change the color of a blue flame, we are led to trace the extrication of a yellow light to some other cause.

It is known that carbonic oxide gas, in a certain state, and likewise light hydro-carbonated gas, give out yellow light during their combustion. If a splinter of wood (and various other vegetable substances may be used) be lighted, and in a few seconds again extinguished, the white vapor or smoke that issues from it gives a fine yellow color to blue flame. If the carbonized extremity of the wood be brought into contact, or only near to the flame, there is a profuse extrication of yellow light from the exterior or brush flame; and if the extremity of the carbonized wood be held quite above the flame, there is a copious discharge of yellow light, similar to that of the brush flame, but which might, with more accuracy, be termed luminous vapor than a flame. In all these cases, it is possible that a minute quantity of aqueous vapor may be present; but if, after the wood has been lighted, and the flame extinguished, the combustion of the carbonized portion be allowed to proceed, until an attenuated, extremely light, and spider-web-like substance alone remains, the minutest particle of this substance, when brought to the margin of the blue flame produces a discharge of light of a fine yellow color; and, in this case, no moisture can be present. In this way, a beautiful flame, of a yellow color from the base to the apex, may be produced, and which is altogether free of any unsteady or flickering motion.

When a piece of wood that has been carbonized in a spirit flame, and completely extinguished, is brought under a blue flame, a very slight motion given to the wood will be followed by an extrication of yellow light; and by rubbing two such pieces of wood, the one upon the other, under the flame, the whole of

the latter will acquire a yellow color. Scraping the carbonized wood with a knife produces a similar effect; but, in this case, larger particles are also separated, which give out light of a brilliant yellow color, and much better suited for the purpose of illumination, than the dull mat yellow of diluted alcohol, or that produced by the smoke, &c. of carbonized wood above described. For, in both these cases, the light is similar, and proceeds from a modification of the same part of the flame. By means of carbonized wood &c. the exterior attenuated brush flame of a candle or lamp may be rendered visible all over the flame, a yellow color being communicated to it. It may be remarked, that there is reason to believe that pure carbon would not produce the effects above described; but that has not been procured for experiment. If, when a blow-pipe is used with a candle, the wick be cut short, so that the stream of air may pass through the white part of the flame, the jet has a fine blue color: when the jet has a red or reddish yellow-color, it will be found that particles of the carbonized portion of the wick, or of soot, are carried off by the current of air from the blow-pipe; and whether a blow-pipe or bellows is used, the yellow light is similarly produced in all cases in which the combustion is supported by solid carbonaceous substances.

When a wire or rod of glass is introduced into a blue flame, yellow light is commonly extricated, and this always proceeds from some foreign substance on the surface of these bodies, such as condensed smoke, dust, &c.; it is almost impossible to handle glass or unpolished metals, particularly when the hands are hot, without leaving condensed perspiration on their surfaces. An opportunity occurred of pointing out this circumstance to Dr. Brewster, to whom had been exhibited, and with whom were repeatedly discussed, all these experiments on colored flame, &c. It was stated by him, that glass or mica introduced into a blue flame, produced yellow light; but it was immediately shown, that when a glass rod was brought to a white heat, and thereby perfectly cleaned, previous to its being introduced, when cold, into a blue spirit flame, no change of color was produced; and that the yellow light proceeded from some foulness of the glass. Apparently clean glass, and wire, kept for a length of time exposed in a room with a fire, have been observed to change the color of blue flame. But as soon as the glass or wire is made red-hot, the yellow light disappears, and cannot be made to re-appear without a renewal of the combustible substance on their surface; and hence a monochromatic lamp giving a yellow light cannot be constructed by a coil of wire in the centre of a blue flame.

SENSATION OF HEAT.

THE term *heat*, in its ordinary acceptance, is used to express a feeling or sensation which is produced in us when we touch a hot body. We say that the heat of a body is more or less intense, according to the degree in which the feeling or sensation is produced in us.

The touch, by which we acquire the perception of heat, like the eye, ear, and other organs, is endowed with a sensibility confined within certain limits; and even within these we do not possess any exact power of perceiving or measuring the degree of the quality by which the sense is effected. It is the same with heat. If two bodies be very different in temperature, the touch will sometimes inform us which is the hotter; but if they be nearly equal, we shall be

unable to decide which has the greater or which the less temperature. But even this information, rude and unsatisfactory as it is, is more full than that which the evidence of the touch frequently furnishes.

In the first place, the touch can never be affected by heat which exists in the latent state. Ice-cold water, and ice itself, *feel* to have the same temperature, and to contain the same quantity of heat: and yet ice-cold water contains a great deal more heat than ice; nay, that it can be compelled to part with its redundant heat, and to become ice; and that this redundant heat, when so dismissed, may be made to boil a considerable quantity of water. But it is not only in the case of latent heat, which cannot be felt at all, that the touch fails to inform us of the quantities of heat in a body. Different bodies are raised to the same temperature by very different quantities of heat. If water and mercury, both at the temperature of 32° be touched, they will be felt to be equally cold; and if they be both raised to 100° , and then touched, they will be felt to be both equally warm: and the inference would be, that equal quantities of heat must have been in the meanwhile communicated to them. Now, on the contrary, the quantity of heat which has been communicated to the water is not less than thirty times the quantity which has been imparted to the mercury. In fact, to cause the same change of temperature, and, therefore, the same feeling of heat, in different bodies requires very different quantities of heat to be imparted to them. It is plain, therefore, that the sense of touch totally fails in the discovery of the quantities of heat which must be added to different bodies in order to produce in them the same change of temperature.

But it may be said, that the thermometer itself is here in the same predicament as the touch, and that this scientific measure of heat likewise fails to indicate the quantity of that principle which has been added or subtracted. Setting aside, however, the estimation of quantities of heat, the sense of touch is not less fallacious in the indications which it gives of temperature itself; and here, indeed, the error and confusion into which it is apt to lead, when unaided by the results of science, are very conspicuous. If we hold the hand in water which has a temperature of about 90° , after the agitation of the liquid has ceased we shall become wholly insensible of its presence, and will be unconscious that the hand is in contact with any body whatever. We shall, of course, be altogether unconscious of the temperature of the water. Having held both hands in this water, let us now remove the one to water at a temperature of 200° , and the other to water at the temperature of 32° . After holding the hands for some time in this manner, let them be both removed, and again immersed in the water at 90° ; immediately we shall become sensible of *warmth* in the one hand, and *cold* in the other. To the hand which had been immersed in the cold water, the water at 90° will feel *hot*; and to the hand which had been immersed in the water at 200° , the water at 90° will feel *cold*. If, therefore, the touch be in this case taken as the evidence of temperature, the same water will be judged to be hot and cold at the same time.

If, in the heat of summer, we descend into a cave, we become sensible that we are surrounded by a cold atmosphere; but if, in the rigour of a frosty winter, we descend into the same cave, we are conscious of the presence of a warm atmosphere. Now, a ther-

thermometer suspended in the cave, on each of these occasions, will show exactly the same temperature; and, in fact, the air of the cave maintains the same temperature at all seasons of the year. The body, however, being in the one case, removed from a warm atmosphere into a colder one, and, in the other case, from a very cold atmosphere into one of a higher temperature, becomes, in the latter case, sensible of warmth, and, in the former, of cold.

Thus, we see that the sensation of heat depends as much on the state of our own bodies, as that of the external bodies, which excite the sensation; the same body at the same temperature producing different sensations of heat and cold, according to the previous state of our bodies when exposed to it. But even when the state of our bodies is the same, and the temperature of external objects the same, different objects will feel to us to have different degrees of heat.

In the ordinary state of an apartment, at any season of the year, the objects which are in it all have the same temperature, and yet to the touch they will feel warm or cold in different degrees: the metallic objects will be coldest; stone and marble less so; wood still less so; and carpeting and woollen objects will feel warm.

When we bathe in the sea, or in a cold bath, we are accustomed to consider the water as colder than air, and the air colder than the clothes which surround us. Now, all these objects are, in fact, at the same temperature. A thermometer surrounded by the cloth of our coat, or suspended in the atmosphere, or immersed in the sea, will stand at the same temperature.

A linen shirt, when first put on, will feel colder than a cotton one, and a flannel shirt will actually feel warm; yet all these have the same temperature.

The sheets of the bed feel cold, and blankets warm; the blankets and sheets, however, are equally warm. A still, calm atmosphere, in summer, feels warm; but if a wind arises, the same atmosphere feels cool. Now a thermometer suspended under shelter, and in a calm place, will indicate exactly the same temperature as a thermometer on which the wind blows.

These circumstances may be satisfactorily explained, when it is considered that the human body maintains itself almost invariably, in all situations, and at all parts of the globe, at the temperature of 96° ; that a sensation of cold is produced when heat is withdrawn from any part of the body faster than it is generated in the animal system; and, on the other hand, warmth is felt when either the natural escape of the heat generated is intercepted, or when some object is placed in contact with the body, which has a higher temperature than that of the body, and, consequently, imparts heat to it. The transition of heat from the body to any object, when that object has a lower temperature, or from the object to the body, when it has a higher temperature, depends in a certain degree, on the conducting power of the objects severally; and the transition will be slow or rapid according to that conducting power. An object, therefore which is a good conductor of heat, if it has a lower temperature than the body, carries off heat quickly, and feels cold; if it has a higher temperature than the body, it communicates heat quickly, and feels hot. A bad conductor, on the other hand, carries off and communicates heat very slowly; and, therefore, though at a lower temperature than the body, is not felt to be colder, and, though at a higher temperature, not felt to be warm.

To explain the apparent contradiction implied in the fact, that the use of a fan produces a sensation of coolness, even though the air which it agitates is not in any degree altered in temperature, it is necessary to consider that the air which surrounds us is generally at a lower temperature than that of the body. If the air be calm and still, the particles which are in immediate contact with the skin acquire the temperature of the skin itself, and having a sort of molecular attraction, they adhere to the skin in the same manner as particles of air are found to adhere to the surface of glass in philosophical experiments. Thus sticking to the skin, they form a sort of warm covering for it, and speedily acquire its temperature. The fan, however, by the agitation it produces, continually expels the particles thus in contact with the skin, and brings new particles into that situation. Each particle of air, as it strikes the skin, takes heat from it by contact, and, being driven off, carries that heat with it, thus producing a constant sensation of refreshing coolness.

Now, from this reasoning it would follow, that if we were placed in a room in which the atmosphere has a higher temperature than 96° , the use of a fan would have exactly opposite effects, and, instead of cooling, would aggravate the effects of heat; and such would, in fact, take place. A succession of hot particles would, therefore, be driven against the skin, while the particles which would be cooled by the skin itself would be constantly removed.

It may be objected to some of the preceding reasonings, that glass and porcelain, though among the worst conductors of heat, generally feel cold; this, however, is easily explained. When the surface of glass is first touched, in consequence of its density and extreme smoothness a great number of particles come into contact with the skin; and each of these particles, having a tendency to an equilibrium of temperature, takes heat from the skin until they acquire the same temperature as the body which is in contact with them. When the surface of the glass, or perhaps the particles to some very small depth within it, have acquired the temperature of the skin, then the glass will cease to feel cold, because its bad conducting power does not enable it to attract more heat from the body. In fact, the glass will only feel cold to the touch for a short space of time after it is first touched. The same observation will apply to porcelain and other bodies which are bad conductors, and yet which are dense and smooth. On the other hand, a mass of metal, when touched, will continue to be felt cold for any length of time, and the hand will be incapable of warming it, as was the case with the glass.

A silver or metallic tea-pot is never constructed with a handle of the same metal, while a porcelain tea-pot always has a porcelain handle. The reason of this is, that metal being a good conductor of heat, the handle of the silver or other metallic tea-pot would speedily acquire the same temperature as the water which the vessel contains, and it would be impossible to apply the hand to it without pain. On the other hand, it is usual to place a wooden or ivory handle on a metal tea-pot. These substances being bad conductors of heat, the handle will be slow to take the temperature of the metal; and even if it do take it, will not produce the same sensation of heat in the hand. A handle apparently silver, is sometimes put on a silver tea-pot, but, if examined, it will be found that the covering only is silver; and that at the points where the handle joins the vessel, there is a small interruption between

the metallic covering and the metal of the tea-pot itself, which space is sufficient to interrupt the communication of heat to the silver which covers the handle. In a porcelain tea-pot, the heat is slowly transmitted from the vessel to its handle; and even when it is transmitted, the handle, being a bad conductor, may be touched without inconvenience.

A kettle which has a metal handle cannot be touched when filled with boiling water, without a covering of some non-conducting substance, such as cloth or paper; while one with a wooden handle may be touched without inconvenience.

The feats sometimes performed by quacks and mountebanks, in exposing their bodies to fierce temperatures, may be easily explained on the principle here laid down. When a man goes into an oven raised to a very high temperature, he takes care to have under his feet a thick mat of straw, wood, or other non-conducting substance, upon which he may stand with impunity at the proposed temperature. His body is surrounded with air, raised, it is true, to a high temperature; but the extreme tenuity of this fluid causes all that portion of it in contact with the body at any given time to produce but a slight effect in communicating heat. The exhibitor always takes care to be out of contact with any good conducting substance; and when he exhibits the effect produced by the oven in which he is inclosed upon other objects, he takes equal care to place *them* in a condition very different from that in which he himself is placed; he exposes them to the effect of metal or other good conductors. Meat has been exhibited, dressed in the apartment with the exhibitor: a metal surface is in such a case provided, and, probably, heated to a much higher temperature than the atmosphere which surrounds the exhibitor.

THE BRAIN AND NERVES.

THE brain, in its general aspect, appears to be merely a mass of pulpy matter, marked with various convolutions, and inclosed in the cavity of the *cranium*, as in a place of safety, and of strength. Its soft and yielding texture, its susceptibility to lesion, and the extreme importance of its functions to the economy of life, required that it should be well protected. Hence, the *cranium* is not the only organ by which the brain is defended from external injury. There are other helps and appliances to boot, both without and within. The hair, the skin, the muscles, the *periosteum*, are the outer defences; then comes the *cranium*—the main, the chief defence—first, by its hard and impenetrable texture, and then by its globular form, by which the impulse of a blow is dissipated, and spread over the whole surface of the skull, before it can reach the brain. The *dura mater*, the arachnoid, and the *pia mater*, are the inner defences.

If we take a view of the fabric of the brain *en masse*, we shall find that it is composed of two main portions,—the *cerebrum*, and the *cerebellum*—that is, the brain proper, and the lesser brain—to which we ought, perhaps, to add the spinal marrow also. For though anatomists have usually described it as being merely a prolongation issuing from the brain, and not as forming of itself a portion of the brain; yet, physiologists begin now to regard the *cerebrum*, the *cerebellum*, and the *spinal marrow*, as constituting, in their *ensemble*, but one organ.

In man, the brain has been thought to be larger, in proportion to the bulk of the body, than in any

other animal. But this does not prove to be the fact; it is only larger in proportion to the nerves that issue from it. The average weight of the brain is said to be about two pounds and a half, avoirdupois. It attains to its full size at the age of seven, but does not seem to attain to its full weight till the age of puberty.

Nerves are longitudinal filaments, or bundles of longitudinal filaments, issuing from the brain, or spinal cord, each enveloped in a fine membrane, and containing a sort of pulp or marrow, though some physiologists doubt the existence of this envelope. The nervous system is double, and strictly symmetrical, the nerves issuing in pairs, one nerve for the right side, and another for the left. They have many anastomoses, and many branches or ramifications, by which they are distributed through, or over the several organs to which they are sent. They are endowed with a very delicate sensibility. If a nerve is divided, or compressed, or irritated, by being laid bare, as in tooth-ache, it occasions the most acute pain—a pain specifically different from that of every other tissue or organ. In amputations, the patient will sometimes ask why the pain differs in different portions of, the section made by the knife. Nerves have but little of extensibility, beyond what may be called their natural tone. If you pull a portion of nerve forcibly in different directions, you lengthen it but very little; hence it has but little of contractility, or of recoil, though cut through transversely; and thus, in amputations, the nerve does not shrink in the proportion of the muscles, or skin, but remains projecting.

Bichat regards the nerves as forming two systems totally distinct—the one belonging specially to animal life; namely, the cerebral—sensible; the other, belonging specially to organic life; namely, the ganglionic—insensible; the former transmitting impressions to and from the brain, and including the nerves of the brain and spinal marrow; the latter connected with the functions of digestion, circulation, respiration, and secretion, and exemplified in the great sympathetic and its branches.

Plants have neither brain nor nerves; hence they can neither think nor feel. Yet Dutrochet regards them as being furnished with multitudes of nervous molecules—the primary source of all vegetable motion. This, like his doctrine of muscular molecules, is a topic that demands and deserves further investigation.

DOMESTIC DYEING.

(Resumed from page 71.)

RED DYES.

THE coloring matters employed for dyeing red, are kermes, cochineal, archil, madder, carthamus, and Brazil-wood.

Kermes is a species of insect, affording a red color by solution in water; but it is not so beautiful as cochineal, which is likewise an insect, brought from America. The decoction of cochineal is of a very beautiful crimson-color. Alum brightens the color of the decoction, and occasions a crimson precipitate. Muriate of tin gives a copious fine red precipitate.—Archil is a paste formed of a species of lichen pounded, and kept moist for some time with stale urine.—Madder is the root of a well-known plant, *rubia tinctorum*.—Carthamus is the flower of a plant cultivated in Spain and the Levant. It contains two coloring matters: a yellow, which is soluble in water; and a red, in-

soluble in water, but soluble in alkaline carbonates. The red coloring matter of carthamus, extracted by carbonate of soda, and precipitated, by lemon-juice, constitutes the rouge employed by ladies as a paint. It is afterwards ground with a certain quantity of talc. The fineness of the talc, and the proportion of it mixed with the carthamus, occasion the difference between the cheaper and dearer kinds of rouge.—Brazil-wood is the wood of a tree growing in America and the West Indies. Its decoction is of a fine red color.

None of the red coloring matters has so strong an affinity for cloth as to produce a permanent red, without the assistance of mordants. The mordants employed are alumine, and oxide of tin; oil, and tan, in certain processes, are also used; and tartar, and muriate of soda, are frequently called in as auxiliaries.

To dye woollens of red, crimson, and scarlet colors.—Coarse woollen stuffs are dyed red with madder or archil: but fine cloth is almost exclusively dyed with cochineal, though the color which it receives from kermes is much more durable. Brazil-wood is scarcely used, except as an auxiliary, because the color which it imparts to wool is not permanent.

Wool is dyed crimson, by first impregnating it with alumine, by means of an alum bath, and then boiling it in a decoction of cochineal, till it has acquired the wished-for color. The crimson will be finer, if the tin mordant is substituted for alum; indeed, it is usual with dyers to add a little nitro-muriate of tin, when they want fine crimsons. The addition of archil and potass to the cochineal, both renders the crimson darker, and gives it more bloom; but the bloom very soon vanishes. For paler crimsons, one-half of the cochineal is withdrawn, and madder substituted in its place.

Wool may be dyed scarlet, the most splendid of all colors, by first boiling it in a solution of murio-sulphate of tin, then dyeing it pale yellow with quercitron bark, and afterwards crimson with cochineal; for, scarlet is a compound color consisting of crimson mixed with a little yellow.

It is well known that cloth dyed in the piece is never saturated throughout with the coloring matter. Indeed such cloths may be distinguished from those dyed in the wool, by examining their edges when cut; for their interior is always of a fainter tint than the surfaces—sometimes almost white. If, to avoid this, the cloth be made of wool dyed before spun, it is more expensive, but becomes more agreeable to wear, never showing white edges. Some colors can only be given to cloth after it is manufactured; for example, cochineal scarlet, the beauty of which would be impaired by carding, spinning, and fulling. Scarlet is therefore always dyed in the piece, and liable to exhibit white edges. The discovery of the Count de la Boulaye-Marsillac, director and professor in the school of the Gobelins, entirely removes this defect. His theory is, that the water with which the cloth is soaked before immersion in the dye-vat, occupying already the interstices of the cloth, prohibits the entrance of the coloring liquid; so that the cloth, though strongly wrung to displace the water, is able only to receive the coloring matter to a certain depth. His aim then was to have the cloth so moistened as to be fit for the process, and yet to have the water so completely removed from the interior of the cloth, as to permit the dye to enter; and this he effects by making the moistened cloth pass through

between rollers placed within and at the bottom of the dye-vat; so that, the web passing from one windlass through the dye-vat, and being strongly compressed by the rollers in its passage to another windlass, all the remaining water is driven out into the coloring liquid (and diluting it to that extent), and is replaced by the coloring liquid, so as to receive color into its very centre. The winding is continued backwards and forwards from one windlass to the other, and through the rolling-press, till the dye is of sufficient intensity. Cloths thus dyed, are of so intense a color as to appear less bright than scarlets are by the common process; but this deeper reflection of red rays may be obviated by adding, to the bath, some turmeric or fustic.

To dye silks of red, crimson, and other colors.—Silk is usually dyed red with cochineal, or carthamus, and sometimes with Brazil-wood. Kermes does not answer for silk, madder is scarcely ever used for that purpose, because it does not yield a color bright enough. Archil is employed to give silk a bloom; but it is scarcely ever used by itself, unless when the color wanted is lilac.

Silk may be dyed crimson, by steeping it in a solution of alum, and then dyeing it in the usual way in a cochineal bath.

The colors known by the names of *puppy, cherry, rose, and flesh-color*, are given to silk by means of carthamus. The process consists merely in keeping the silk as long as it extracts any color, in an alkaline solution of carthamus, into which as much lemon-juice, as gives it a fine cherry-red color, has been poured.

Silk cannot be dyed a full scarlet: but a color approaching to scarlet may be given to it, by first impregnating the stuff with murio-sulphate of tin, and afterwards dyeing it in a bath, composed of four parts of cochineal and four parts of quercitron bark. To give the color more body, both the mordant and the dye may be repeated. A color approaching to scarlet may also be given to silk, by first dyeing it in crimson, then dyeing it with carthamus; and lastly, yellow, without heat.

To dye linens and cottons, of red, scarlet, and other colors.—Cotton and linen are dyed red with madder. The process was borrowed from the East; hence the color is often called Adrianople, or Turkey-red. The cloth is first impregnated with oil, then with galls, and lastly with alum. It is then boiled for an hour in a decoction of madder, which is commonly mixed with a quantity of blood. After the cloth is dyed, it is plunged into a soda ley, in order to brighten the color. The red given by this process is very permanent; and when properly conducted, it is exceedingly beautiful. The whole difficulty consists in the application of the mordant, which is by far the most complicated employed in the whole art of dyeing.

Cotton may be dyed scarlet, by means of murio-sulphate of tin, cochineal, and quercitron bark, used as for silk, but the color is too fading to be of any value.

(To be continued.)

EFFECTS OF CENTRIFUGAL FORCE.

IN a corn-mill, the grain, after being admitted between the stones through an opening in the centre of the upper stone, is then kept turning round between them, and is, by its centrifugal force, always tending and travelling outwards until it escapes as flour from the circumference. A man, if he lie down

on a turning millstone with his head near the edge, falls asleep, or dies of apoplexy, from the new pressure of blood on the brain. A wet mop, or bottle-brush, made to turn quickly on its handle as an axis, throws the water off in all directions, and soon dries itself. Sheep, in wet weather, thus discharge the water from their fleeces, by a semi-rotatory shake of the skin. Water-dogs, on coming to land, dry themselves by the same action. A tumbler of water, placed in a sling, may be made to vibrate like a pendulum with gradually increasing oscillation, and at last to describe the whole circle, and continue revolving about the hand, without spilling a drop:—the water, by its inertia of straightness, or centrifugal force, tending more away from the centre of motion towards the bottom of the tumbler, even when that is uppermost, than towards the earth by gravity.

As solid bodies laid on a whirling table are thrown off, so water in a vessel caused to spin round in any way, as on the centre of a horizontal wheel, instead of lying at the bottom, is raised up all round, against the sides of the vessel.

Water, poured obliquely into a funnel, runs round the interior of it, and often leaves an open passage of air all the way down through it, as if there were merely a lining of water to the funnel. The centrifugal force of the turning water, is a chief reason of this phenomenon.

Carriages are often overturned in quickly rounding corners. The inertia carries the body of the vehicle in the former direction, while the wheels are suddenly pulled round by the horses into a new one. A loaded stage-coach running south; and turned suddenly to the east or west, strews its passengers on the south side of the road. Where a sharp turning in a carriage-road is unavoidable, the road towards the outside of the bend should always be made higher than at the inside, to prevent such accidents.

A man or a horse turning a corner at speed, leans much inwards or towards the corner, to counteract the centrifugal force that would throw him away from it. In skating with great velocity, this leaning inwards at the turnings becomes very remarkable, and gives occasion to the fine variety of attitudes displayed by the expert; and if a skater, in running, finds his body inclined to one side, and in danger of falling, he merely makes his skait describe a slight curve towards that side, when the tendency of his body to move straightly, or its centrifugal force, refusing to follow in the curve, allows the foot to push itself again under the body, and to restore the perpendicularity. Skating becomes to the intelligent man an intellectual, as well as a sensitive or bodily treat, from its exemplifying so pleasingly the laws of motion. The last example explains, also, why a hoop roller along the ground goes so long without falling: if it incline to one side, threatening to fall, by that very circumstance the part touching the ground is made to bend its course to that side, and as in the case of the skater who turns his foot, the supporting base is again forced directly under the mass of the body.

A coin dropped on the table or floor, often exhibits the same phenomenon. It is said to run and hide itself in the corner. Just before falling, if not obstructed, it describes several turns of a decreasing spiral, the minute examination of which is a pleasing mathematical exercise.

By reason of centrifugal force also, it is easier to do feats of horsemanship in a small ring, as at our theatres, than if the animal were running on a straight road. We see the man and horse always inclining inwards, to counteract centrifugal force, and if the rider tend to fall inwards, he has merely to quicken the pace; if to fall outwards, he has to slacken it, and all is right again.

A half-formed vessel of soft clay, placed in the centre of the potter's table, which is made to whirl, and is called his wheel,—opens out or widens merely by the centrifugal force of its sides, and thus assists the worker in giving its form. A ball of soft clay, with a spindle fixed through its centre, if made to turn quickly, soon ceases to be a perfect ball. It bulges out in the middle, where the centrifugal force is great, and becomes flattened towards the ends, or where the spindle issues. This change of form is exactly what has happened to the ball of our earth. It has bulged out seventeen miles at the equator, in consequence of its daily rotation, and is flattened at the poles in a corresponding degree. A mass of lead that weighs 1000 pounds at our pole, weighs about five pounds less at the equator, by reason of the centrifugal force.

GUANO.

We consider a notice of this remarkable production, only recently imported from South America, worthy of a place among new inventions. It is a new description of manure of which a small quantity produces the most extraordinary effects on vegetation. If what we have heard of it, in this respect, be borne out by facts, which we have no reason to doubt, the importation of this article will be a real blessing to the country. At a time when a cry of distress, and apprehended famine, is heard throughout the land, the introduction of a new manure, increasing the product of agriculture, in a surprising degree, is a valuable boon to society, deserving the most serious attention. As we believe the precise nature and properties of the guano are not yet known in this country, we shall be obliged to any correspondent, who, through our Journal, will throw some light on the subject. We have been informed that the guano, which, we understand, is the dung of sea-birds, contains in its composition a very large proportion of carbonate of ammonia, or some other compound of ammonia, to which its fertilising properties are attributable. We have before us a report of many trials, made with the guano manure, from which it will suffice to quote an example to show that it is not without reason that we treat the subject as one of importance.

From Mr. Smith, Gunton Park, Norfolk:—

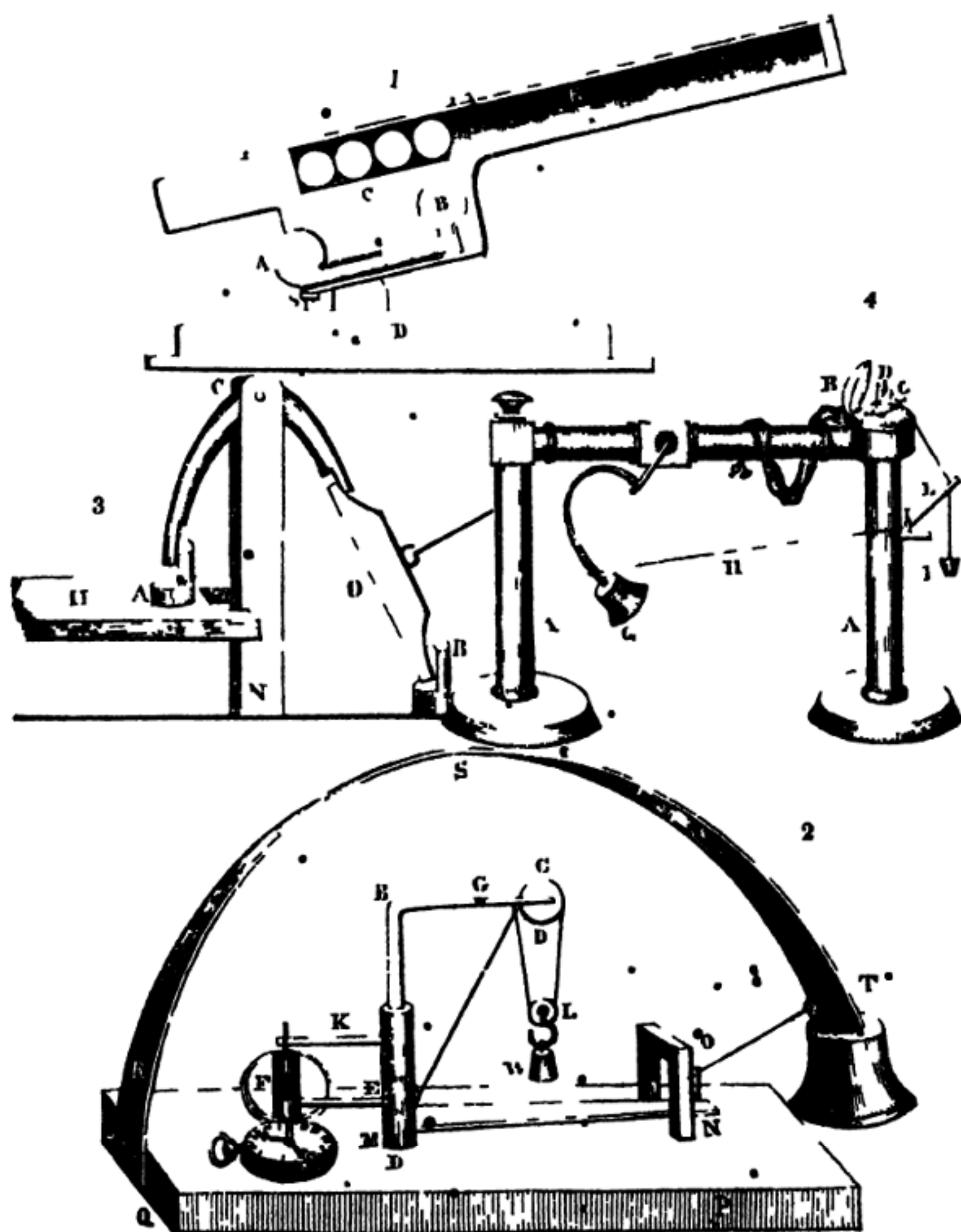
"I applied 200lbs. to an acre, and on the same field, on an equal space of land, 15 bushels of bone dust. Both were drilled into the ground with seed wheat. The bone dust gave 4½ quarters of wheat, the guano, 6 quarters, 2 bushels, 1½ pecks." Its effects on other kinds of produce are equally remarkable. In one instance the crop of clover in a field which had been manured with guano, the preceding year, exhibited an increase in the produce of 50 per cent. A gentleman, who made a trial on hops, observes that the effect was most extraordinary, and concludes by saying:—"I feel confident that if the guano can be bought, at a moderate price, it will be the most valuable manure we ever had."

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NEW EDITION

[1½d.



ALARMS, OR ALARUMS.

ALARM, OR ALARUM

Is a term applied to a variety of instruments constructed for the purpose of producing sufficient sound or noise to awaken a person from sleep, or otherwise to give notice of some occurrence, or warning of the state of the time, &c.

Glenny and Darby's Fire and Burglary Alarm.—

The object of this invention, for which a patent has been taken out, is to indicate by means of a placard or signal, containing the written information, in what part or situation of the premises to which it is attached, a fire or burglary has taken place immediately upon either having happened. This is effected by placing an alarm-bell within a box, (having the appearance of any article of furniture,) the internal mechanism of which is connected by lines or wires to every part of the premises deemed to be hazardous. These lines, carried from the alarum in the manner of bell-wires, are at their extremities connected to triggers, any one of which being discharged, releases its line immediately, and sets off the alarm-bell within the box, firing a pistol also, if attached thereto; and at the same time, causes a slider or label to be presented, containing the words, "fire," or "thieves," in such a part of the premises, describing where, and which of the two occurrences. The construction of the apparatus is as follows:—A box of any external appearance, placed in the bed-room or elsewhere as a piece of furniture, contains the alarm-bell, which is connected to the striking part of a clock. Each of the lines before described are connected at one end to a piece of metal as a trigger, which is hooked to a hold-fast, placed in such a situation that, by the opening of a door or window, the trigger is liberated, and the line which passes over the pulleys placed at every angle, is drawn back by the other end being attached to a weight inside the box; the weight in descending strikes against a lever formed by a projecting pin, fixed to, and turning on, an horizontal axis. This axis carries a series of lever pins, corresponding with the number of lines, weights, &c. employed; so that any one of the weights by falling, causes the axis to turn, and by means of an arm projecting from the axis, a wire connected to the striking part is pulled, and the alarm set off. The labels or slides before mentioned are each connected by a line or chain to its respective weight, which, on its descent, projects or draws out to view the label conveying the required information. In adapting this apparatus to indicate the occurrence of fire, small lines of catgut, or threads of sufficient strength, are substituted for the before-mentioned lines, which are carried across the ceilings or round the cornices of the apartments to be guarded. Some one of these slender strings, it is considered, would be soon burnt by the ascent of the flame, and give early notice of the destructive element, by the alarm bell to which it was attached being put in action, which would at the same time indicate the situation of the fire. Prior to the granting of this patent, many of the mechanical arrangements described under it were in use, and the patentee's claim to invention may be considered as limited to the introduction of the direction labels, which, in a large building, might prove of eminent use.

Russell's Fire Alarm.—This apparatus is put into operation by the expansion of a small quantity of air contained in an instrument called a pulse glass, which consists of two bulbs, with a small tube of communication between them. Into this vessel is put some liquid, usually colored, so as to about half

fill it, the remaining space being occupied by air; it is hermetically sealed. This instrument is so extremely sensible of a slight increase of temperature, that on placing merely the hand upon one of the bulbs, or by gently breathing upon it, the liquid is rapidly forced out through the tube into the other bulb, owing to the expansion of the air within that bulb, to which the warmth is applied, and producing an apparent ebullition in the liquid by the bubbling of the air through it. When these bulbs are equipoised upon an axis placed midway between them, it is obvious that the liquid flowing into either bulb will cause it to preponderate; and to obtain from this preponderating action sufficient force to set off an alarm, Mr. Russell contrived the following arrangement:—Fig. 1, where A represents one of the glass bulbs nearly filled with the liquid, which should also fill the tube of communication up to the opening into the bulb B; the whole of this vessel is inclosed in a cavity cut out of a block of wood, except a portion of A, which is exposed for the purpose of being influenced by an increase of temperature. The block turns freely upon a centre or fulcrum at C, fixed upright in a stand D. E is a long mortised lever or tube, containing four leaden balls, so placed over the fulcrum as to rest in equilibrio. Upon heat being applied to the bulb A, the air above the liquid rapidly expands, and drives it into B; the weight being thus increased on that side, causes the lever to descend in the direction of the line F, while at the same instant the leaden balls suddenly roll down the inclined plane, accelerating the descent of the lever, and impart to it a considerable degree of force, which it is evident may be almost indefinitely increased by lengthening the lever, or augmenting the rolling weights. As motion is thus produced, attended with great power, its application to the ringing of a bell, or any number of them, or the firing of a gun, may be easily understood, all that is required being a crank with a wire connecting it to the alarm used. If a water pipe and stop-cock were attached to the fulcrum of the lever, the plug of the latter would thereby be opened, and the floor underneath be deluged with water.

Colbert's Fire Alarm.—This consists of a column of mercury in a tube, with a floating piston, which ascends and descends as the mercury expands and contracts. A rod from the piston is connected at its upper end to a lever, which, on being raised, releases a click or detent, and discharges the alarm. The apparatus is provided with a dial plate and index, pointing to the degrees of heat, which is to be adjusted to a few degrees of heat above the temperature of the atmosphere, or above the utmost height to which it is expected the mercury might rise from natural causes during the night. It is inclosed in a case of open fret-work, for the purpose of readily transmitting the heat, and is to be deposited in the well of a stair-case, or other desirable place.

Congreve's Fire Alarm.—The late Sir William Congreve suggested the employment of two metal plates placed in contact, with a cement between them, that would melt at a low temperature. These plates were to be suspended by a thread to opposite corners of a room, when it was considered that a slight increase of heat would melt the cement, cause the plates to fall asunder and discharge the alarm.

Fig. 2 represents a watch alarm, which the inventor states he has made several of, and that they answer extremely well. In a solid frame of wood

P Q about 8 inches by 4, and 1 thick, is inserted a metallic rod, bent into a right angle at **B**, to which are attached a small rod **K**, and two fixed pulleys **D E**. **F** is a cylindrical piece of wood, having inserted at one end the pipe of a watch key, by which it may be made to rest on the pivot of the watch, (the watch being sunk a little into the frame,) and turns with the minute hand, and at the other, a pin which keeps it steady by passing through a hole in the rod **K**. A thread which is fixed to the piece **F**, and may be rolled round it, passes under the pulley **E** over **D**, and round the moveable pulley **L**, to which the weight **W** is attached; and being brought through a hole in the rod **B C** is fixed there by the pin **G**. This pin is used to regulate the length of the thread so that when it is completely wound off the cylinder **F**, the weight **W** may rest on the plane **N**, which is moveable on a pin at **M**. The bell is fixed to one end of a long spring **R S T**, the other end of which is fastened to the board at **R**; at **T** is fixed a string, which keeps the bell in the position represented in the figure, by means of a bit of wood **O**, inserted into two notches, one in the frame and the other in the horizontal part of the frame **N**; the friction of the bit **O** preventing the frame from falling. It will be easily perceived that by winding the thread a certain number of times round **F**, the weight **W** will be raised to a height from which it will take it so many hours to descend to the plane **N**, and that when it does reach that plane and press upon it, the bit **O** is released from the notch, and the elasticity of the spring will make the bell ring with considerable violence.

An improved mode of releasing the bell, described in the foregoing plan, is exhibited in Fig. 3, wherein the parts are drawn upon a larger scale. In this figure the bit of wood **O** is supposed to be tightly pulled by the string attached to the spring of the bell, its lower end being detained by a fixed piece **B**, and its upper end held by a bent piece of brass, which turns upon a centre at **C**, and whose other end sustains the plane **H** by pressing against the piece **A**. The descent of the weight depressing the plane **H**, causes the bent piece of brass to swing loose and release the piece of wood which is connected to the bell.

Fig. 4 represents a watch alarm that is sold in the shops of London, and which we have seen perform with considerable accuracy. The expense of it is only seven shillings. **A A** are turned mahogany stands; **B** the watch laid in a velvet cushioned cavity adapted to receive it, and placed in such a position, that the hour at which a person may wish to rise, shall be placed opposite to a fixed index **C**. A fine line, consisting of a single horse hair, with a loop at the end of it, is then laid into a notch of a guide-piece **D**, and the loop is then slipped over the hour hand of the watch. At **E** is a light ivory lever; to this the horse hair is tied about midway of its length, with a weight **F** suspended to its highest end. The bell **G**, fixed on its steel spring is then brought into the position shown by the line **H**, the extremity of which line is provided with a brass wire hook, then passed over the extremity of the lever, and put on to the upright pin **I**. When, by the process of time, the hour hand has arrived at the period proposed, which is opposite to the point of the index, the horse hair slips from it, the little weight thereby becomes unsupported, pulls down the ivory lever, raising the hook of the pin, which releasing the spring sets the bell ringing.

ELECTRICITY OF THE TORPEDO.

THE electricity of the Raia torpedo was known at a very early period, and accounts of its properties are to be found in the writings of Pliny, Appian, and others. In the *Experimenta circa res diversas naturales* of Redi, published in 1678, are mentioned the imperfect observations of fishermen upon the properties of this animal. Lorenzini, about the same time, published an account of its anatomical structure, with illustrative engravings.

In 1702, Kæmpfer, in his *Amanitates Exotica*, describes his experiments on the torpedo. One singular circumstance might be doubted, if it had not been confirmed by the accurate observations of Mr. Walsh, viz. that any person, by holding his breath at the time he touched the animal, might avoid all sensation of the shock.

The first suspicions that the cause of the shock from the torpedo is electrical, are to be found in Dr. Bancroft's *Natural History of Guiana*; but until the appearance of the valuable papers of Mr. Walsh, in the *Phil. Trans.* for 1773 and 1775, little was effected towards the proof of this fact. He placed a living torpedo upon a wet napkin, and formed a communication through five persons, all of whom were insulated. The person at one extremity touched some water in which a wire proceeding from the wet napkin terminated; the last person in the series having a similar mode of communication with a wire which at intervals could be brought in contact with the back of the animal. In this manner shocks were communicated to the five, and afterwards to eight persons. From the general result it appears that, as in the case of common electricity, glass, and other insulating, or non-conducting bodies, intercepted the shock, whilst metals and other conductors transmitted it. Walsh did not, however, succeed in affecting the electroscope, or in obtaining a spark by the electricity of the torpedo. Mr. Walsh, holding a large and powerful specimen in both hands, and grasping the electric organs above and below, plunged it a foot beneath the surface of some water, and again raised it an equal height in the air. The moment the lower surface of the torpedo touched the water in descending, he always gave a violent shock; a still more powerful one was produced at the instant that the same surface emerged from the water in ascending. Both these shocks were attended by a contortion of the body, as if the animal was anxious to make its escape. The intensity of the shock under water was scarcely one-fourth of that at the surface, and not much more than one-fourth of those given in the air. The number of shocks appeared to be about twenty in a minute.

The shock, in general, was not perceptible beyond the finger with which it was touched; and out of 200 shocks Mr. Walsh experienced one only which affected him above the elbow. If the torpedo were insulated, it was able to give forty or fifty shocks without any diminution of force, to persons who were also insulated. Whenever the animal gives a shock its eyes are depressed, and thus Mr. Walsh was enabled to tell, by observing the eyes, when the animal attempted to make an electrical discharge, even upon non-conducting bodies.

Other interesting experiments were made by Mr. Walsh, which it is unnecessary to detail.

Dr. Ingenhouz, in 1773, made numerous experiments at Leghorn, on the torpedo. Sometimes the shock was slight, and at other times so powerful as almost to oblige him to quit his hold of the animal.

Spallanzani also experimented upon the torpedo. He found that the shock was more powerful when the animal was laid upon a plate of glass; and states, that on irritating the torpedo, he invariably obtained the shock, whether the animal was in or out of the water. He also found that some minutes before the torpedo expired, the shocks were not given at intervals, as in the healthy state of the animal, but were changed into a reiterated succession of small shocks. During a space of seven minutes of this action his fingers experienced 316 shocks; there was then an interruption, and the animal, immediately before it died, gave a few very slight shocks. But the most curious discovery of Spallanzani on this subject, was, that even the foetus of the torpedo possessed the same electrical property before it was born.

The experiments of MM. Humboldt and Gay Lussac, on the electric irritability of the torpedo, are important. They were made in 1805; and the following is a succinct account of the results obtained:—

1. A person much in the habit of receiving electric shocks, can support, with some difficulty, the shock of a vigorous torpedo fourteen inches long. The action of the fish below water is not perceptible, and is not felt until it is raised above the surface of the water.

2. Before each shock, the animal moves its pectoral fins in a convulsive manner, and the violence of the shock is always proportional to the surface of contact.

3. The organs of the torpedo cannot be discharged by us at our pleasure, nor does it always communicate a shock when touched. It must be irritated before it gives the shock, and in all probability it does not keep its electrical organs charged. It charges them, however, with extraordinary quickness, and therefore is capable of giving a long series of shocks.

4. The shock is experienced when a single finger is applied to a single surface of the electric organs, or when the two hands are placed one on the upper and one on the under surface at the same time, and in both these cases the shock is equally communicated, whether the person is insulated or not.

5. If an insulated person touches the torpedo with the finger, it must be in immediate contact, as no shock is received if the animal is touched with a key, or any other conducting body.

6. The torpedo being placed upon a metallic plate, so that the inferior surface of its electrical organ touched the metal, the hand that supported the plate felt no shock, although the animal was irritated by another insulated person, and when it was obvious, from the convulsive motions of its pectoral fin, that it was in a state of powerful action.

7. If, on the contrary, a person supports with his left hand the torpedo placed on a metallic plate, and touches with his right hand the upper surface of the electric organ, a violent commotion will be felt in both his arms at the same instant.

8. A similar shock will be received if the fish is placed between two metallic plates, the edges of which do not touch, and if a person applies a hand to each plate at the same instant.

9. If, under the circumstances of the preceding experiments, there is a connexion between the edges of the two plates, no shock will be experienced, as a communication is now formed between the two surfaces of the organ.

10. The organs of the torpedo do not affect the

most delicate electrometer. Every method of communicating a charge to the condenser of Volta was tried in vain.

11. A circle of connexion being formed by a number of persons, between the upper and under surfaces of the organs, they received no shock until their hands were moistened in water. The shock was equally felt when two persons who had their right hand applied to the torpedo, instead of taking hold of each other's left hands, plunged a piece of metal into a drop of water placed upon an insulated body.

12. By substituting flame in place of a drop of water, no sensation was experienced until the two pointed pieces of metal came in contact with the flame.

13. No shock will be experienced, either in air or below water, unless the body of the fish is immediately touched. The torpedo is unable to communicate its shock through a layer of water, however thin.

14. The least injury to the brain of this animal prevents its electrical action.

For a detail of the anatomical structure of this curious fish, the reader is referred to the paper of the celebrated Hunter, published in the *Phil. Trans.* for 1773.

One part of it, however, is so important, that we shall extract it.

"The nerves," Hunter states, "inserted into each electric organ, arise by three very large trunks from the lateral and posterior parts of the brain. The first of these, in its passage outwards, turns round a cartilage of the cranium, and sends a few branches to the first gill and to the anterior part of the head, and then passes into the organ towards its anterior extremity. The second trunk enters the gills between the first and second openings, and after furnishing it with small branches, passes into the organ near the middle. The third trunk, after leaving the skull, divides into two branches, which pass to the electric organ through the gills; one between the second and third openings, the other between the third and fourth, giving small branches to the gill itself. These nerves having entered the organs, ramify in every direction between the columns, and send in small branches on each partition, where they are lost.

"The magnitude and the number of the nerves bestowed on these organs, in proportion to their size, must, on reflection, appear as extraordinary as the phenomena they afford. Nerves are given to parts either for sensation or action. Now if we except the more important senses of seeing, hearing, smelling, and tasting, which do not belong to the electric organs, there is no part, even of the most perfect animal, which, in proportion to its size, is so liberally supplied with nerves; nor do the nerves seem necessary for any sensation which can be supposed to belong to the electric organs. And, with respect to action, there is no part of any animal with which I am acquainted, however strong and constant its natural actions may be, which has so great a proportion of nerves. If it be, then, probable that these nerves are not necessary for the purposes of sensation or action, may we not conclude that they are subservient to the formation, collection, or management of the electric fluid, especially as it appears evident, from Mr. Walsh's experiments, that the will of the animal does absolutely control the electric powers of its body, which must depend upon the energy of the nerves."

Mr. Cavendish constructed an artificial torpedo

of wood, connected with glass tubes and wires, and covered with a piece of sheep-skin leather. To render the effect of this instrument more like that of the animal, with regard to the difference in the shock in and out of water, it was necessary to substitute thick leather in the place of the wood, and with this improvement the apparatus succeeded admirably. In air, the sensation of the shock was experienced at the elbows, but under water it was confined chiefly to the hands. On touching this artificial torpedo with one hand under water, a shock was obtained as powerful as if it had been touched by both hands. Being touched under water with two metallic spoons, it gave no shock, but in air the shock was very strong. Cavendish also made an estimate between the strength of his artificial torpedo and that dissected by Hunter, with reference to surface. His own battery consisted of seventy-six feet of coated surface; and he calculated that the animal retained a charge fourteen times as great as that of the battery, or was equivalent to 1061 feet of coated glass.

MINIATURE PAINTING.

THE art of painting in miniature is of very ancient date. It is practised either on vellum or ivory.

The best method in painting on vellum, is to glue the edge of the vellum to a copper-plate or board, over which it is strained in this manner. Let your vellum be every way a finger's breadth larger than what you strain it on. Moisten the fair side of the vellum with a piece of fine wet linen, and put a piece of white paper on the other side. Then apply it to the plate or board, stretching it equally in all directions, lap the edges nicely round and glue them, taking care to let no glue pass under the part of the vellum on which you mean to paint. When the glue dries, and the edges of your vellum are thus fastened, you may proceed with your work; or you may (agreeable to the practice of some painters,) previously give the vellum a light wash of white lead well purified, to serve as a ground.

But ivory, being the material most frequently used at present for painting in miniature, we shall here give the most approved rules for painting on ivory.

It is scarcely necessary to remark, that the first essential point towards excellence in this as in all other branches of painting, is a thorough and well grounded knowledge in drawing, both from plaster, and from the life; without correctness of drawing the greatest brilliancy of tints will at last be unsatisfactory. We should therefore recommend to the student in miniature, to continue, at his leisure hours, to copy from large drawings or busts, in chalks or water-colors, as correctly as possible, which is the best means of giving facility to the hand in the drawing of smaller figures.

Painting in miniature is of all others the most delicate and tedious in its process, being performed wholly with the point of the pencil. It is only fitted for works of a small size, and must be viewed near.

Preparing the Ivory.—Of ivory there are various kinds, the distinction of which in this art is of very material consequence. Ivory, newly cut, and full of sap, is not easily to be judged of; the general transparency it exhibits in that state, almost precluding the possibility of discovering whether it is coarse-grained or fine, streaky or the contrary, unless to the artist who, by a long course of experience, is familiarised to it. The best way to discover the quality of it is, by holding it grain ways to the light, then holding it up and looking through it, still

turning it from side to side, and very narrowly observing whether there are any streaks in it; this you will, unless the ivory is very freshly cut, easily discover; and in this you cannot be too particular. There is a species of ivory which is very bad for painting on, although it has no streaks in it, being of a horny coarse nature, which will never suffer the colors to be thrown out in the brilliant manner a fine species of ivory will; you are therefore not only to be cautious in choosing ivory free from streaks, but likewise that which has the finest grain and close. We shall now proceed to treat on the manner of preparing the ivory for painting on.

You are to heat a smoothing iron in so small a degree that you can hold your hand on the face of it, so long as you can reckon three or four in moderate time: then put your ivory between a clean piece of folded paper, on which place the hot iron, turning your ivory frequently, until it becomes a transparent white: for you are to observe that very particularly, an opaque white not answering for face-painting in miniature, as it would give a harshness and unpleasant appearance to the picture.

When you think the ivory is sufficiently white for your purpose, lay it under some flat weight until it cools, as that will prevent its warping. Then proceed to prepare it: for which purpose you must pound some pumice-stone in a mortar, as clear and as fine as you can, which put into a fine linen or cambric bag, tying it about midway, tight, but leaving room for the pumice-dust to sift through the bottom. Then get a long mustard-bottle, perfectly clean and dry, in which suspend the pumice-dust, covering the top with the muzzle of the bag, so that nothing can come out, then shake the bottle smartly in your hand, when the fine particles of the pumice will sift out, and remain at the bottom of the bottle, thereby preventing any coarse grains from being amongst what you are going to use, which would very materially injure your ivory. Your pumice-dust being prepared, scrape the leaves with a sharp pen-knife, until the scratches of the cutting saw are entirely obliterated; then take either a piece of Dutch polishing rush, or a piece of middling fine patent glass paper, and carefully polish your ivory with it, not by passing your hand backwards and forwards, but in a circular manner, until you have it pretty level; then strew some of your pumice-dust on the ivory, and put a few drops of water on it: which done, with your muller work on it in a circular manner as before, until you find every part has equally received the pumice, which you will know by its exhibiting a dead grave appearance: those parts which have not received the pumice continuing to shine in spots, which you must still labour to do away with your pumice and muller. When you find it pumiced to your satisfaction, take a clean sponge and fair water, with which gently wash your ivory free from the pumice-dust; taking care not to rub it hard, for fear of giving the ivory a gloss that would prevent your colors from taking on it so pleasant as you could wish; after this lay your ivory to dry, and in a few hours it will be fit for use. Then paste it on a piece of wove paper, by touching the back of it merely at the edges; as gum-water, or any other cement, being put near the centre of your ivory, will cause a dark unpleasant spot perhaps to appear through, in the very part where your face is to be painted.

Colors.—In painting the face, the yellows that are used are five, viz.: gall-stone, terra Sienna, Notting-ham ochre, Roman ochre, and Naples yellow; the

latter three of which are opaque colors, the other transparent. The greens are confined to one, which is sap-green. The blues are verditer, Prussian blue, indigo, smalt, ultramarine, and Antwerp. The reds are carmine, drop-lake, Chinese vermilion, and Indian red. Under the class of reds, may also be put burnt terra Sienna, its color inclining much that way, though more to the orange. The only browns if any are used in the face are burnt umber and terra de Cassel, and they are only to be used in the mixture of dark shades.

For painting draperies, we shall only add to the above colors, lamp-black, king's yellow, and flake white.

Compound Tints.—Purple is formed of either ultramarine, Prussian blue, smalt, or indigo, mixed with either carmine or drop-lake. Ultramarine, although the most beautiful and brilliant of colors by itself, yet in any mixture it loses that perfection, but still retains a sufficient share of brightness to render it a desirable tint in the purplish grey shadows of the face. Prussian blue, mixed as before-mentioned, makes a bright or dark purple according as the quantities of either colors are portioned; but indigo makes it still darker, owing to its great natural depth of color. Smalt and carmine, or lake, form nearly the same tint as ultramarine, and may be used nearly for the same purpose.

Grey.—Of grey tints there are various kinds, according to the subjects they are required for. A warm grey tint may be made by duly portioning burnt terra Sienna, Prussian blue, and drop-lake: the more terra Sienna in it, the warmer the tint; the more Prussian blue and lake, the colder. Another grey tint, used with success by some eminent miniature painters, was composed of Prussian blue and Chinese vermilion, but on account of the unkind manner with which vermilion incorporates with any other color, it required a greater proportion of gum than ordinary to make them work or keep together. A third grey tint, which is an excellent one, is formed of drop-lake, sap green, and Prussian blue.

Olive Tints.—A very fine olive tint is formed of gall-stone, Nottingham ochre, and carmine, or lake: and another of sap green and lake simply.

Of Hair Tints.—A beautiful hair color, either, dark or light, according to the quantities of colors, is made of carmine, lamp-black, and sap-green. The manner of forming it is only to be acquired by practice: but when once attained, will be found worth the time of the trial. That very difficult tint which is often to be met with in children's hair, by the proper junction of these colors will be produced to perfection. Other hair tints may be made of terra de Cassel simply, or by the addition of lamp-black. Some excellent painters make all their hair tints of burnt terra Sienna, lamp-black, and Nottingham ochre, the latter being added only when there is light hair wanting to be represented. Burnt umber has been substituted for terra Sienna, along with the lamp-black, and forms a good tint; but care must be taken to avoid either the greenish or reddish cast, which it is apt to produce.

Tints for fine Linen, Gauze, &c.—Of all tints in transparent painting, such as are the miniature works of the present day, there are none more difficult to ascertain: for the delicacy not only of mixture, but the delicacy of touch, conveys the idea of beauty in the thinness and folding of fine linen or gauze, the true painting of which throws a veil over the defects in other parts of the picture. We shall therefore only observe, that any of the tints, under

the head of grey will, properly managed, answer the purpose. Having now pointed out the manner of preparing the delicate transparent tints for miniature painting, we shall defer the treatment of the grosser ones, namely, those for draperies, to another opportunity.

(To be continued.)

FULMINATES, FULMINATING POWDERS, PERCUSSION CAPS, &c.

THE death of Mr. Hennell, of the Apothecaries' Company, who was last week blown to pieces by the explosion of a large quantity of fulminating powder, which he was manufacturing for the use of the East-India Company, has at present so rivetted the attention of the public upon these dangerous substances, that we shall but be discharging our duty by conveying an account of the true nature of them; and such we extract from the best possible source, the report given by Dr. Ure to the Board of Ordnance upon the subject. The Dr. says:—"Of these explosive compounds there are several species; such as fulminating gold, mercury, platinum, silver—besides the old fusible mixture of nitre, sulphur, and potash. The only kind at all interesting in a manufacturing point of view is the fulminate of mercury, now so extensively used as a priming to the caps of percussion locks. Having published a paper in the *Journal of the Royal Institution* for 1831, upon gunpowder, the result of an elaborate suite of experiments, I was soon afterwards requested by the Hon. the Board of Ordnance to make such researches as would enable me to answer, in a satisfactory practical manner, a series of questions upon fulminating powders, subservient to the future introduction of percussion muskets into the British army. The following is a verbatim copy of my report upon the subject:—

"To the Secretary of the Board of Ordnance.

"Sir,—I have the honor of informing you, for the instruction of the Honorable the Board of Ordnance, that the researches on fulminating mercury, which I undertook by their desire, have been brought to a satisfactory conclusion, after a numerous, diversified, and somewhat hazardous series of experiments. The following are the questions submitted to me, with their respective answers:—

"Question 1. What proportions of mercury, with nitric acid and alcohol of certain strengths, will yield the greatest quantity of pure fulminate of mercury?

"Answer. One hundred parts, by weight, of mercury, must be dissolved with a gentle heat, in 1000 parts (also by weight) of nitric acid, spec. gr. 1.4; and this solution, at the temperature of about 130° Fahr., must be poured into 830 parts by weight of alcohol, spec. gr. 0.830. Note. 830 parts of such alcohol, by weight, constitute 1000 by measure; and 1000 parts of such nitric acid, by weight, constitute 740 by measure. Hence, in round numbers; one ounce weight of quicksilver must be dissolved in 7½ oz. measures of the above designated nitric acid, and the resulting solution must be poured into 10 oz. measures of the said alcohol.

"Question 2. What is the most economical and safe process for conducting the manipulation, either as regards the loss of nitrous gas and residuum, or as respects danger to the operator; also, what is the readiest and safest mode of mixing the fulminate intimately with its due proportions of common gunpowder?

Answer. The mercury should be dissolved in the acid in a glass retort, the beak of which is loosely inserted into a large balloon or bottle of glass or earthenware, whereby the offensive fumes of the nitrous gas disengaged during the solution, are, in a considerable measure, condensed into liquid acid, which should be returned into the retort. As soon as the mercury is all dissolved, and the solution has acquired the prescribed temperature of about 130° , it should be slowly poured, through a glass or porcelain funnel, into the alcohol contained in a glass matraas or bottle capable of holding fully six times the bulk of the mixed liquids. In a few minutes bubbles of gas will proceed from the bottom of the liquid; these will gradually increase in number and magnitude till a general fermentative commotion, of a very active kind, is generated, and the mixture assumes a somewhat frothy appearance. A white voluminous gas now issues from the orifice of the matraas, which is very combustible, and must be suffered to escape freely into the air, at a distance from any flame. These fumes consist of an ethereous gas, holding mercury in suspension or combination. I have made many experiments with the view of condensing this gas, or, at least, the mercury, but, with manifest disadvantage to the perfection of the process of producing fulminate. When the said gas is transmitted, through a glass tube, into a watery solution of carbonate of soda, a little oxide of mercury is, no doubt, recovered; but the pressure on the fermentative mixture, though slight, necessary to the displacement of the soda solution, seems to obstruct or impair the generation of the fulminate; this effect is chiefly injurious towards the end of the operation when the gaseous fumes are strongly impregnated with nitrous gas. When this is not allowed freely to come off, a portion of sub-nitrate or nitrate of mercury is apt to be formed, to the injury of the general process and the product.

As soon as the effervescence and concomitant emission of gas are observed to cease, the contents of the matraas should be turned out upon a paper double filter, fitted into a glass or porcelain funnel, and washed by the affusion of cold water till the drainings no longer redden litmus paper. The powder adhering to the matraas should be washed out and thrown on the filter by the help of a little water. Whenever the filter is thoroughly drained, it is to be lifted out of the funnel, and opened out on plated copper or stone-ware, heated to 212° Fahr. by steam or hot water. The fulminate being thus dried, is to be put up in paper parcels of about 100 grains each; the whole of which may be afterwards packed away in a tight box, or bottle with a cork stopper. The excellence of the fulminate may be ascertained by the following characters. It consists of brownish-grey small crystals which sparkle in the sun, are transparent when applied to a slip of glass with a drop of water, and viewed by transmitted light. These minute spangles are entirely soluble in 130 times their weight of boiling water; that is to say, an imperial pint of boiling water will dissolve 67 grs. of pure fulminate. Whatever remains indicates impurity. From that solution beautiful pearly spangles of fulminate fall down as the liquid cools.

Question 3. May the gas or vapor produced by the inflammation of the fulminate of mercury when combined with a portion of gunpowder, be considered in its nature corrosive of iron or brass?

Answer. I have suggested to Mr. Lovell, of Waltham Abbey works, that the fulminate may be

probably diluted most advantageously with spirit varnish made of a proper consistence by dissolving sandarach in alcohol. When well mixed with this varnish, a small drop of the mixture will suffice for priming each copper cap or disc; and as the spirit evaporates immediately, the fulminate will be fixed to the copper beyond the risk of shaking or washing away. On the Continent, tincture of benjamin is used for the same purpose; but as that balsamic resin leaves in combustion a voluminous coal, which sandarach does not, the latter, which is the main constituent of spirit varnish, seems better adapted for this purpose. It is sufficiently combustible, and may be yet made by a due proportion, to soften the violence of the explosive mercury on the nipple of the touch-hole. Fulminate prepared by my formula has no corrosive influence whatsoever on iron or steel; and, therefore, if such a medium of applying it, as I have now taken leave to suggest, should be found to answer, all fears on the score of corrosion may for ever be set at rest.

Question 4. How far is the mixture (of fulminate and gunpowder) liable to be affected by the moisture of the atmosphere, or by the intrusion of water; and will such an accident affect its inflammability when dried again?

Answer. Well made fulminate, mixed with gunpowder and moistened, undergoes no change, nor is it apt to get deteriorated by keeping any length of time in a damp climate or a hazy atmosphere. Immersion in water would be apt to wash the nitre out of the pulverine; but this result would be prevented if the match or priming mixture were liquefied or brought to the pasty consistence not with water, but spirit varnish. Such detonating caps will be indestructible, and might be alternately moistened and dried without injury.

Question 5. Is it at all probable that the composition would be rendered more inflammable or dangerous of use, by the heat of tropical climates?

Answer. No elevation of temperature of an atmospheric kind, compatible with human existence, could cause spontaneous combustion of the fulminating mercury, or the detonating matches made with it. In fact its explosive temperature is so high as 367° of Fahrenheit's scale, and no inferior heat will cause its detonation.

Question 6. Is the mercurial vapor or gas arising from the ignition of a great number of primers, and combined with the smoke of gunpowder in a confined space (as in the case of troops in close bodies, squares, casements, &c.) likely in its nature to be found prejudicial to human health?

Answer. I have exploded in rapid succession of portions, 100 grains of fulminate of mercury (equivalent to 300 or 100 primers,) in a close chamber of small dimensions, without experiencing the slightest inconvenience at the period, or afterwards, though my head was surrounded by the vapors all the time of the operation. These vapors are, in fact, so heavy that they subside almost immediately. When the fulminate mixed with pulverine is exploded in the primers by condensed masses of troops, the mercury will cause no injury to their health, nor one 100th part of the deleterious impression on weak lungs which the gases of exploded gunpowder might by possibility inflict. These gases are all, *theoretically* speaking, noxious to respiration; such as carbonic acid gas, azote, carburetted hydrogen, and sulphuretted hydrogen, a deadly gas. Yet the soldier who should betray any fear of gunpowder smoke would be an object of just ridicule.

"To find out what sort of liberties might be taken with fulminate of mercury in handling it, Mr. Lovell, of the Manufactory of Arms, placed 3 grains on an anvil, putting the end of a steel punch gently on the top of it, and while so placed he covered the fulminate over with a drachm of dry gunpowder. He then ignited the fulminate by a blow on the punch with the hammer, but not a grain of the gunpowder was lighted, though it was blown about in all directions. He then placed a train of fulminate as thick as a quill, and about 3 feet long, on a table, and covered it over entirely with gunpowder, except about an inch at one end; this he lighted with a hot iron, when the whole train went off without blazing a grain of the gunpowder, which he swept together and blew up afterwards with a match. He then took a tin box, containing 500 copper caps, made a hole in the top of the box, and through this hole ignited one of the caps in the middle, by means of the punch and hammer on the outside; only two other caps besides the one struck exploded: no injury was sustained by the remainder, except being discolored. This he tried repeatedly, and always with the same kind of result, never more than three or four caps exploding. He then made a steel rammer red hot, and passed it through the hole in the box right in amongst the caps, but it only ignited them where the hot iron came in actual contact with the priming composition; when, however, he placed a few grains of gunpowder loose among the caps, the hot iron lighted this, and produced a flame that blew off the whole of them.

"The same thing has been tried at Woolwich, where large packages of percussion caps (some thousands) have been fired at with musket balls, and only a few of the caps actually hit by the ball exploded; but when any cartridges were connected with the packages, the whole, caps and all, were blown up. The flame of the fulminate is therefore hazardous, but being so very ethereal, it requires for making primes, an admixture of some combustible matter, as a little gunpowder, to condense or modify the flame."

ELECTRO-MAGNETISM AS A MOVING POWER.

THE Consul-General of the Netherlands, in a late communication, announces the removal of the obstacle to the practical application of electro-magnetism as a propelling power:—"A private gentleman, Mr. Elias, of Haarlem, has just published the description of a new machine invented by him, for the application of electro-magnetism as a substitute for steam. The object of the inventor has been chiefly to remedy the defect which, in 1839, rendered the otherwise ingenious invention of M. Jacobi, of St. Petersburg, a total failure, in as far as practical utility is concerned. Those defects originated, it seems, in the erroneous supposition, that the power of the magnetic bars exclusively resides in their extremities—whence the form hitherto given to all electro-magnetic machines; viz., that of a horse-shoe,—which while it occasions an unavoidable interruption of the magnetic stream at each new inversion of the poles, at the same time leaves the power resident in the remaining part of the bars wholly unemployed. The new invention of Mr. Elias, on the contrary, has the very great advantage of rendering effective the full power of the

magnetic stream uninterruptedly, and throughout the whole body of the apparatus. This consists of two concentric rings of soft iron, standing on the same plane, of which the external one is immovable, whilst that on the inside revolves round its own axis. By means of a piece of copper wire, wound about each of these rings, he has given them six magnetic poles, placed at equal distances from one another; the whole being so contrived that the one ring exerts its inducing power on the other throughout the whole circumference, and always at the same distance. A small, but very perfect, model of this important invention is now open to public inspection here; and the result of its operation is allowed, by those skilled in such matters, to be such as to ensure the most triumphant success."—*Mining Journal*.

MEMORANDA.

Improved Tinning.—Messrs. Richardson and Braithwaite have patented certain improvements in tinning vessels, which consist in employing an alloy instead of pure tin, which is thus composed:—10 oz. of nickel, 7 oz. of thin sheet iron, and 10 lbs. of tin are melted together, under a flux composed of 1 oz. of borax, and 3 oz. of powdered glass; which produces an alloy much better adapted to the purpose of tinning than any thing heretofore adopted. It is used in the same way as pure tin has heretofore been employed, and produces a firmer, more adherent, less fusible, and much whiter surface.

Caoutchouc Pavement.—Mr. Freeman, of Westminster, has patented an improved pavement; to produce which, India-rubber is cut up into threads and placed within a cylinder having a series of teeth on its inner surface; a second cylinder similarly equipped on its external surface revolves within the first, by which means the India-rubber becomes heated and reduced to a sort of pasty mass. In this state, it is saturated with charred sawdust, and then pressed into moulds: the bottom of the mould is covered with a layer of coarse sand, which becomes imbedded in the composition, on that which in use is to be the upper surface of the block. The blocks thus formed are to be hardened by continued exposure to the atmosphere. For street paving, the size recommended is twelve inches square and three inches thick, while for foot pavements a thickness of one inch will be sufficient; for covering walls, the blocks are to be united by means of India-rubber cement. Ground stone, or sand, may, it is stated, be used instead of the charred sawdust.

Gunpowder Machine.—M. Laurent has exhibited to the Academy of Sciences, at Paris, the drawings and description of a machine, for the improved fabrication of gunpowder; by means of which, the employment of manual labour, except for superintending the working of the apparatus, is entirely superseded. Most of the common causes of accident in this dangerous manufacture are avoided by the new machine, which also makes the powder more rapidly, and with less waste of material, than by the ordinary methods.

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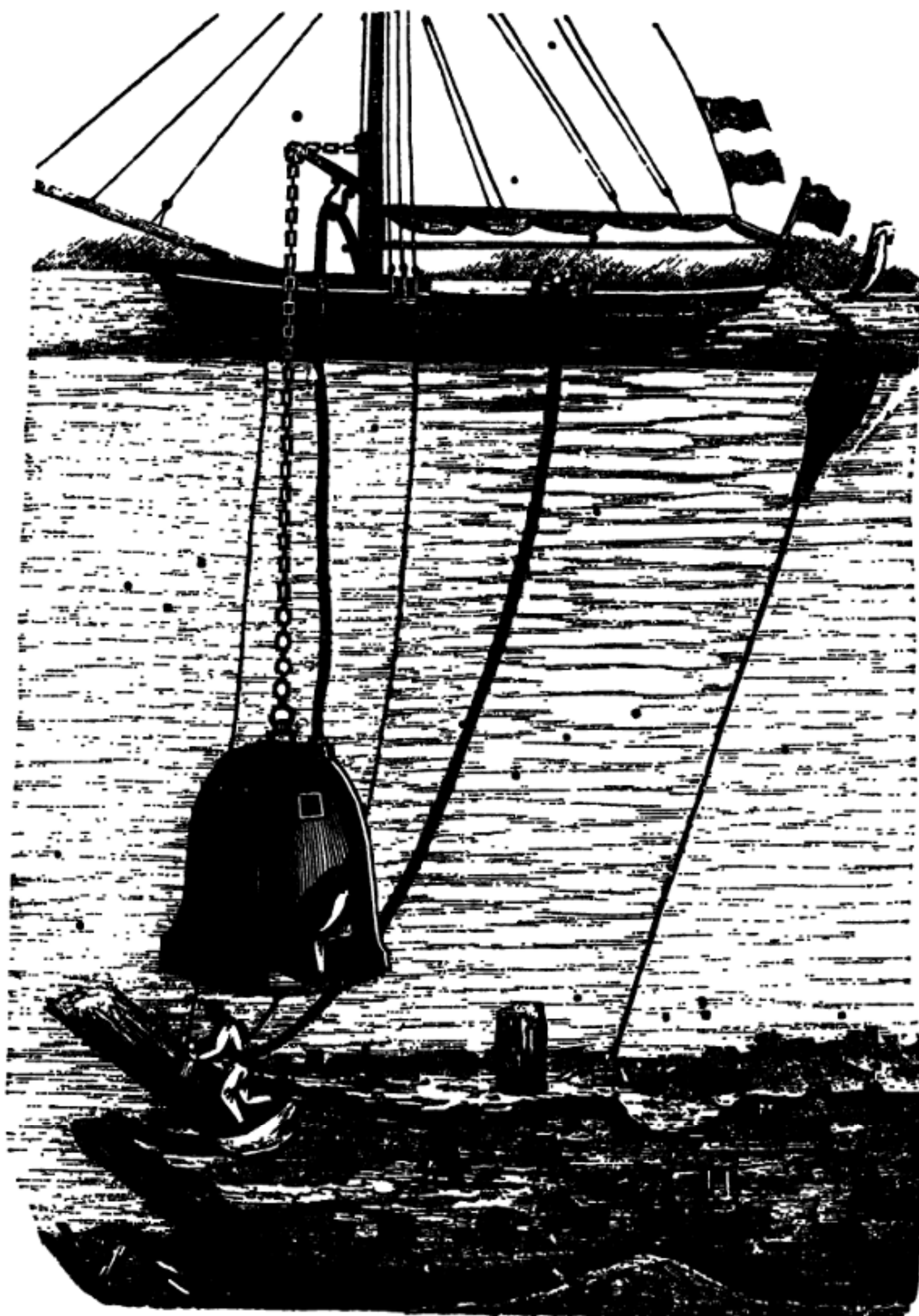
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THE DIVING-BELL.

THE DIVING-BELL AND DR. PAYERNE'S EXPERIMENTS.

Our leader of this week is of somewhat a miscellaneous character, and has for its object the representation of the Royal George, as it appeared previous to its removal by Colonel Pasley; the diving-bell, (the figure given being that used at the Polytechnic Institution.)* The wonderful experiments of Dr. Payerne, to remain under water for a lengthened period without a fresh supply of air; and the very ingenious diving-helmet of Mr. Dean, by the aid of which so much has lately been accomplished.

To illustrate the principle of the diving-bell, take a glass tumbler, plunge it into water with the mouth perpendicularly downwards; you will find that very little water will rise into the tumbler, which will be evident if you lay a piece of cork upon the surface of the water, and put the tumbler over it; for you will see, that, though the cork should be carried far below the surface of the water, yet its upper side is not wetted, the air which was in the tumbler having prevented the entrance of the water; but, as air is compressible, it could not entirely exclude the water, which, by its pressure, condensed the air a little.

The first diving-bell we read of in Europe was tried at Cadiz, by two Greeks, in the presence of Charles V. and 10,000 spectators. It resembled a large kettle inverted. The first of any note was made by Dr. Halley. It is most commonly made in the form of a truncated cone, the smaller end being closed, and the larger one open. It is suspended that it may sink full of air, with its open base downwards, and as near as may be parallel to the horizon, so as to close with the surface of the water. Mr. Smeaton's diving-bell, made in 1788, was a square chest of cast iron, $4\frac{1}{2}$ feet in height, $4\frac{1}{2}$ feet in length, and 3 feet wide, and afforded room for two men to work in it. It was supplied with fresh air by a forcing pump. This was used with great success at Ramsgate. Other contrivances have been used for diving-bells. Within the last thirty years, the diving-bell has been much employed to assist in laying the foundations of buildings under water. A diving-bell, on an improved principle, was constructed, in 1812, by the late Mr. Rennie, and employed in Ramsgate harbour, where it answered so well, that the masonry was laid with the utmost precision. From this period must be dated a new era in the construction of masonry under water, the use of coffer dams being in a considerable degree superseded. The diving-bell was, thence-forward, employed by Mr. Rennie in the construction of all the great harbours which he projected. Round bells of cast iron and copper have been occasionally made for the pearl and coral fisheries of South America, and have been supplied by the Messrs. Rennie for most of the royal dock yards in England, and several of those in the colonies, for the pearl fishery at Ceylon, for the repair of the works at Cronstadt, for many places in Great Britain and Ireland, &c.

The diving-bell represented is made of iron, and is capable of holding 6 or 8 persons. The windows above are for the admission of light, there is a seat

* To show this the better, it is purposely depicted of a much larger proportionate size than the surrounding objects. This extravagance will therefore be overlooked; indeed such is often necessary when one drawing is made subservient to several purposes.

within and also a foot board. The divers being seated the bell descends, being let down gradually by means of a crane or sets of pulleys; when used for practical purposes, these are attached to a barge, and the bell let down through the middle, or from the end or one side, according as convenience suggests. Now it is evident from the fact, that respiration consumes the oxygen, which is the vital principle of the air, and that the noxious gas, carbonic acid, is emitted at every expiration from the lungs, that there should be some contrivance to absorb the one and supply the other. The absorption takes place easily by means of the water into which the bell dips, that fluid being absorbent of carbonic acid gas. To supply the oxygen, an air-pump is used; the pipe connected with this is seen attached to the upper part of the bell, and two persons at work at the pump above, are required to pump into the bell an adequate supply of air. This portion of the apparatus has always hitherto been considered the most troublesome and inconvenient part of the machine, and that it is the most important must be evident, when we reflect that the lives of the divers depend upon the adequate supply of vital air. This renders some late experiments of Dr. Payerne of great interest. This gentleman engages to descend in a diving-bell, and to remain under water for many hours, without any fresh supply of air; he has already remained beneath the surface of the water for hours, without exhaustion or inconvenience. How this is accomplished is at present not known; it is supposed, however, that he makes oxygen equal to his consumption of it, by decomposing chlorate of potash. In this explanation, however, there is much difficulty, because, to decompose the salt, the heat of a flame is requisite, and this of itself would consume a considerable portion of the oxygen formed, and also liberate carbonic acid gas faster than the water would perhaps absorb it, and if lime be employed to absorb the carbonic acid formed, still the difficulty relative to the quantity of oxygen remains. Dr. Payerne's method is at present a secret known only to himself, but we understand that a patent is being taken out for the invention, when becoming public property, we shall be enabled to record all the particulars. If found successful, there is but little doubt of its value in simplifying the construction, and proportionably increasing the utility of the diving-bell, especially when Dr. Payerne has completed a submarine boat, which is now constructing, and he states, may easily be made to travel along for miles at the bottom of the water, without danger to the occupants. Should this be even accomplished, it is evident that the bottoms of harbours, anchorages, and channels may be surveyed with almost equal facility as a plot of land, floating ships may be inspected, wrecks ascertained, and numerous submarine works carried on with ease, which are now impracticable, especially when used in conjunction with Mr. Dean's diving-helmet, of which we are enabled to give the following particulars.

The head of the diver is covered by a helmet of thin sheet copper, large enough to admit of the easy motion of the head, and capable of including 6 or 8 gallons of air. The helmet comes pretty far down on the breast and back, and has in front three eye-holes, covered with glass and protected by brass wires. The copper helmet is attached to a water-proof canvass jacket by means of rivets, &c. so tightly fixed that no water can be introduced to the body of the diver. The junction of the helmet and jacket is stuffed, so that it may clasp the shoulders of the

diver firmly. A leather belt, H, passes round the diver, to which are attached two weights, one before and the other behind, each weighing about 40lbs.



These weights, and a similar one at C, are attached in order that the diver may descend with facility; but in case of any accident occurring when he is at the bottom, the belt is fastened with a buckle in front, which he can instantly unloose, and rise to the surface after the dropping of the weights. The diver is supported with fresh air by means of the flexible water-proof pipe, A, which enters the back of the helmet, and communicates with an air pump wrought above in the barge from which the diver descends. The tube passes under the left arm of the diver, and turning upwards, enters the back of the helmet, being so contrived that the fresh air is made to impinge against the glasses, which in a great measure prevents their being dimmed by the moisture of the breath. From the back part of the helmet there is led an eduction pipe, to allow the escape of the breathed air. In order that the diver may give notice to the attendants at the top, when he requires a hook, tackle, bucket, or any difference in the supply of fresh air, he is furnished with a signal line, B, which passes under his right arm. The diver descends from the side of the vessel either by means of a rope or wooden ladder loaded at the lower end, (more frequently by the former) the weight being kept at a height of about two feet from the ground. When the diver descends to the bottom, the rope is let down, so that it becomes slack, to prevent the motion of the boat from obstructing him, and he carries a line in his hand, that he may, when necessary, return to the rope. In order that the diver may be as comfortable as possible under water, he puts on two suits of flannel, above which he has a complete dress (in one piece, of Mackintosh's water-proof cloth). The water-proof dress covers the body entirely, the only apertures being at the neck and wrists. The opening at the neck comes well up, and is tied round tightly with a bandage, which contrivance, together with the pressure of the air in the helmet, prevents the water from entering the helmet, and the wrists are likewise tightly bound with bandages. The diver is thus enabled to remain for five or six hours at once under water, all the while perfectly dry, his motion being rendered quite steady by heavy weights attached to his shoes.

With this apparatus, the ingenious and enterprising inventor has dived for several wrecked vessels in the Western Highlands of Scotland, at Spithead in England, on the coast of France, and, at Cope-

land island, off Donaghadee, north-east coast of Ireland, at which latter place he has brought up an immense number of silver dollars, several gold coins, some bottles of wine covered with shell fish, and many other curious and valuable articles, from a vessel wrecked there more than thirty years since. At the other places alluded to he met with similar success.

COLORS OF THE DEW-DROP.

THE Rev. Dr. Scoresby has devised a simple method of observing the resplendent light and colors of the dew-drop, by aid of a telescope which can be adjusted a very short focal distance; so that, by being drawn out beyond the usual focus, objects at the distance of only three or four yards may become distinctly visible. There are obviously particular positions, in which the largest number of the drops are always to be seen. The simplest way of finding the fitting globules for examination, is to turn the back to the sun and take the shadow of the observer's head on the ground as the guide. Within a few inches, most brilliant drops, reflecting like the diamond, will be seen, and sometimes exhibiting colors. But, within, perhaps, a yard or two of the shadow, (at an angular distance of 10° or 12°), if the sun have considerable altitude, globules of a most gorgeous character may be observed; whilst others, at a greater distance, will present, by a slight motion of the head, almost all the phenomena in succession of the solar arch. If the globule be to the right of the observer, (the back being to the sun), and any color be seen, let the head be inclined to the right until white light alone is reflected. Then, by slowly returning the head towards the left, a succession of colors will be seen, differing, however, in their order according to the number of reflexions and refractions. When at a large angular distance, (such as nearly half a right angle from the shadow of the head of the observer,) the series commonly observed is blueish, like the sapphire; pale blue; brilliant white, like the diamond; straw color; pink; orange; orange approaching to red. At this angular distance, (40° to 50°), Dr. Scoresby has generally found the nearer drops to the eye (as those within 5 to 10 yards,) exhibiting scarcely more than three different or distinct colors; but in the remote drops, (as those at 15 or 20 yards distance,) the above variety might be seen.

In the globules, however, at small angular distances, the reverse order of colors was observed. On May 1, at eight o'clock in the morning, the sun, being very bright, and the globules of dew numerous and large, Dr. Scoresby observed one, at about a yard from the shadow of his head, of singular beauty and splendour. Its brilliancy, when reflecting only white light, outvied, if possible, that of the diamond: and the tints which successively appeared in examining it with a small telescope, under a slight change of position, were singularly rich, and indeed gorgeous. The globule was a little to the right of the shadow of the head, and when examined, as above recommended, from right to left, the succession of colors was as follows: green, blueish-white, resembling in lustre and fire the diamond. The order here, omitting the two first tints, was that of the primary rainbow.

Dr. Scoresby has not succeeded in determining whether there are any particular angles at which the development of color is resolvable. As observed without a telescope, colors could rarely be seen, except the orange, and that not very distinctly. It

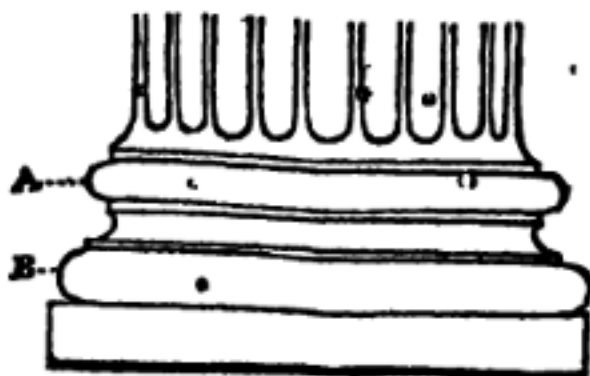
occurred to Dr. Scoresby that the parallax occasioned by the distance of the eyes, might actually bring a different tint to each eye, and so confuse or mix up two tints. And this was found to be so far the fact, in observing the nearer drops of dew, that when examined with one eye, unassisted by the telescope, more distinct tints were seen, especially in looking through a tube or through a small hole in any interposed substance. Reflected obliquely from a plane mirror, however, with one eye placed near the reflecting surface, the spectrum became much more obvious and capable of analysis into different tints.

ARCHITECTURAL MOULDINGS.

THE mouldings used by the Greeks and Romans in their buildings are few and extremely simple; their beauty consisting chiefly in the judicious arrangement and combination of eight forms, so that they should altogether form a bold or delicate contour. These forms were the annulet, or fillet, which is a narrow square moulding that invariably escapes other mouldings and projections, and very often separates one moulding from another, as will be seen in numerous of the following illustrations. When this fillet is somewhat widened without the projection of it being increased, it has obtained the name of *band*. In the following cut, which shows the exact proportions of the Ionic order, the fillet crowns the cornice at top, and also runs as a white line between the fascia and the entablature.



It is also seen to advantage in the following section of the base of an Ionic column, where a fillet is seen above and beneath the *torus*, or large round projecting moulding A, and also above the lower torus, B.



In the simple condition of a fillet, this member is never ornamented, but is to be considered merely as a division, or as a coping, or cover to others; but when it assumes the character of a band, certain ornaments become appropriate. For example, an ornamented band may, with propriety, surround the interior of a window over pilasters, or it may separate the compartments of a ceiling, and is often used

as a string course outside a building, to separate one story from another. In such cases, the ornament will, of course, be consistent with the general style of the building. The simplest and poorest is the *braided* ornament.

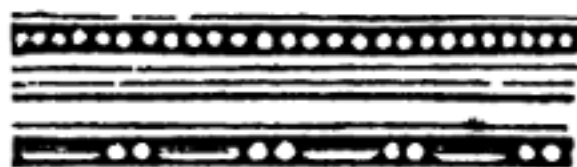
Still more rich are *guilloshes*, two sorts of which are placed beneath. These are of a Venetian origin,



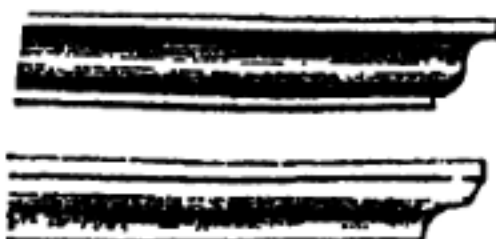
but assimilate well with both Greek, Roman, Moorish, Italian, and it may be said, even with Elizabethan buildings, without much violation of architectural unity. Another ornament peculiar to the band is the *fret*, the varieties of which are almost endless; the Chinese fret is one of the most common of these. It is represented beneath, and will be seen to be composed, as all the frets are, of square fillets crossing each other, whereas guilloshes are curved fillets also intertwined.



The nearest approach to the fillet moulding is the *bead*, a small round moulding. Taste alone will decide when this may be ornamented, and the appropriate ornament; the fret is evident inapplicable, but guilloshes are frequently used with the *torus*, a moulding that is nothing more than a large bead. The torus is shown at A and B, in the capital above given. The small bead is often multiplied, or a series of beads are arranged side by side of each other, forming altogether what is called a *reed*, or a reeded band, pilaster, &c. When placed singly, it may be plain, or else cut into prominences, as given annexed. It may also be made flush with the general surface, or project above it. A bead is sometimes called an *astragal*.



The next, and, perhaps, of all mouldings, that most generally used, is the *ogee*, or *cima*; the contour of which, partly projects and partly retires, or in other words, it consists of two contrary curves, one convex, the other concave. It may be that the upper is concave, and the lower convex, or on the contrary, as is seen beneath.



In the illustration of the Ionic order, given above, it will be seen to occur no less than three times;—1st, in the cornice; 2nd, under the blockcourse, or immediately above the entablature; and 3rdly, between that and the fascia, being crowned in two instances by a fillet. It is bad taste to ornament the ogee too constantly with a fluting ornament, leaves are sometimes admitted as an illustration, yet but seldom. Its beauty consists in bold projection, and in its acting as a foil to richly ornamented parts of the building; and if ornament is admitted into the ogee, it is when the adjoining members are plain. When the ogee of a cornice is not broken by projections of the building, and extends so far as to produce a sameness to the eye, it may be enriched by masks of lions' heads, placed at certain remote distance from each other.

Another moulding of frequent introduction is the *ovolo*, or *quarter round*. This is not merely bold in itself and a good substitute for the ogee, where

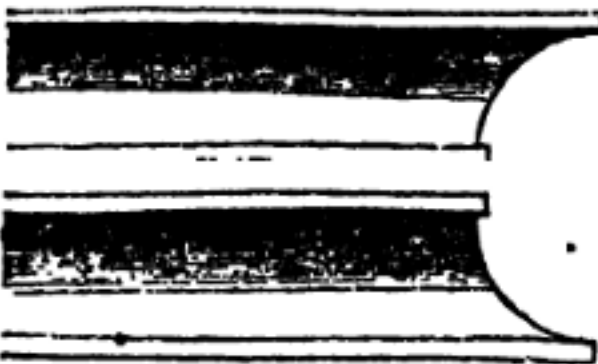
a too frequent repetition of the latter would be objected to, but it affords an introduction of that surpassingly-beautiful Greek enrichment, the *egg and tongue*, than which, no arrangement of simple materials can possibly produce a finer contrast, or so perfect a relief by the shadow cast.

A still greater boldness is given to these mouldings by what is called the *quirk*, which may be described as a twist, or more than ordinary turn of the curve which forms the moulding. This, which is difficult to describe, will be easily understood by the annexed cut, in which A and B are the usual ovolo and ogee mouldings. C is a *quirked ovolo*, and D is a *quirked ogee*.



The *scotia*, or *cassment*, is seen beneath. It is an

elegant moulding, but used only in particular circumstances; it can be considered but as a variety of the *cavetto*, or *hollow*; another moulding of con-



siderable beauty, and well adapted to promote that variety which exists in the Greek buildings. This is, however, by no means of Greek origin, but is usually the crowning, or *corona*, of all of the Egyptian temples, as was illustrated in our last volume. In Gothic architecture, all the above mouldings are used in their simple, unornamented form; and although frets, guilloshes, and the egg and tongue are absent, yet Gothic architecture claims other embellishments as appropriate to the gloomy and mysterious character of its buildings, as these are to the pure and simple Greek. These Gothic embellishments we shall advert to on another occasion.

STORMS.

THE causes of those violent commotions of the atmosphere to which we give the names of storms, tempests, hurricanes, tornados, &c., are involved in obscurity, chiefly from the difficulty of obtaining a precise knowledge of the various circumstances with which they are accompanied. In order to ascertain the general laws of these phenomena, it would be necessary to determine, in a great number of particular instances, the place and time at which the storm begins and ends, the path it describes, the extent of atmosphere disturbed, the direction and force of the wind, and the barometric pressure at every part of the disturbed column during the whole time of its continuance. But several of these points could only be determined from the comparison of a great number of simultaneous observations on that tract of the earth's surface over which the storm passes; while, from the nature of the thing to be observed, it is evident that a few insulated observations is the most that can be expected in almost any case. Besides, a storm for the most part passes over some part of the sea, where, unless a ship unfortunately happens to be caught in it, no observation can be made, or even evidence be obtained of its existence.

It is in the torrid zone that storms display the greatest violence, and rage with most destructive fury. In our latitudes they are comparatively rare, and in the polar regions they seldom amount to more than a strong wind.

Until recently it was generally believed that during a hurricane the wind at every part of the agitated mass blows in a rectilinear and parallel direction, and a storm was considered to be sufficiently explained when it was described as a wind blowing with a velocity of 100 or 120 miles in an hour. A comparison of the recorded accounts of the circumstances attending several storms has of late years shown that this idea was erroneous, and that the phenomena are considerably more complicated.

Franklin appears to have been the first who remarked that storms travel in a direction opposite to the actual movement of the wind at the time the storm is raging; and he ascribed the phenomenon to a great but partial rarefaction of the air, arising from the sudden precipitation of vapours, or other causes, the consequence of which would necessarily be a simultaneous rush of wind from all quarters to fill up the vacuity; and the mass of air being thus set in motion by a sort of aspiration, the gale will be first felt at those places towards which it blows. In a work on winds and monsoons, published in 1801, Colonel Capper was led, from a comparison of the details respecting the hurricanes, at Pondi-

cherry and Madras in 1760 and 1773, to remark that these hurricanes must have been whirlwinds, whose diameters could not exceed 120 miles, and that the velocity of the wind at any point was due to the rotatory velocity of the vortex. He also supposed that, besides the gyratory movement which forms the characteristic of the whirlwind, a storm has probably also progressive motion. Colonel Capper's speculations, however, appear to have met with little attention until the subject was taken up by Mr. Redfield of New York, who, in a series of papers recently published in the American journals, has diligently collected and examined a great number of observations relative to the storms of the West Indies and North American coasts, and arrived at the similar conclusions. The following general phenomena appear to be established:—1. The severest hurricanes originate in tropical latitudes to the north or east of the West India Islands. 2. They cover simultaneously an extent of surface from 100 to 150 miles in diameter, acting with diminished violence towards the exterior, and increased energy towards the interior of that space. 3. The tract over which the hurricane passes is not a straight line. South of the parallel of 30° north latitude, it proceeds in a westerly course inclined to the north; but when it comes to about this parallel, it changes rather abruptly to the north and eastward, and continues to incline gradually more to the east. The average progressive velocity appears to be from fifteen to twenty-five miles per hour. 4. The duration of a storm at any particular place depends of course on the extent of the mass of agitated air, and the progressive velocity; and storms of smaller extent move with even greater rapidity than large ones. 5. The direction of the wind in a hurricane is not in the direction of its progress. When the progressive motion of the storm is westward, the wind at the commencement is from a northern quarter, and during the latter part of the gale from a southern quarter of the horizon. When the progressive motion is eastward, the phenomena are reversed; the wind blows at first from a southern quarter, and towards the end of the gale from a northern quarter of the horizon.

From these phenomena, and particularly the last, Mr. Redfield concludes that the great body of the storm whirls in a horizontal circuit round a vertical or somewhat inclined axis of rotation, which is carried forward with the storm; and that to a spectator placed at the centre, the direction of the rotation is invariably from *right to left*. It is to be understood, however, that the phenomena now described, and the conclusion drawn from them, apply only to the northern hemisphere.

Another fact deserving of attention is, that the barometer, in all latitudes, sinks during the first half of the storm in every part of its track, and rises during the second. This phenomenon is ascribed to the effects of the centrifugal force of rotation; and such is the regularity of its occurrence, that it has been considered as affording of itself a strong proof of the rotatory character of the motion.

Colonel Reid, of the engineers, having been officially employed to restore the government buildings at Barbadoes blown down by the great hurricane of 1831, was led to investigate the subject generally; and in his work, entitled *An Attempt to develop the Laws of Storms, &c.*, he has collected and given the results of an immense number of details, obtained from an examination of ships' logs furnished to him by the admiralty, and other sources. These

results he considers as confirming in all respects the conclusions of Mr. Redfield respecting the gyratory motion of the gale from right to left; its progressive motion in a curved line, first westward, and then towards the north and east; the position of the vertex of the curve at or near the 30th degree of latitude; and the fall of the barometer during the first half of the storm, and its rise during the second. Colonel Reid has also given an account of several great hurricanes in the southern hemisphere, from which it appears that the southern storms follow exactly the same laws as the northern, but in a reversed order. The direction of the rotation is from *right to left*; the centre of the gyrating mass advances first eastwards, then turns towards the south, and falls off towards the south-west and west, the vertex of the curve being at the 30th degree of south latitude. In the northern hemisphere, the West Indies and Atlantic coast of North America appear to be the places where storms most frequently rage; in the southern, the focus of storms appears to be placed near the Mauritius.

The uniformity of the direction of the rotatory motion of the hurricane, and its opposite direction in the opposite hemisphere, was explained by Mr. Redfield from theoretical considerations respecting the origin of storms, which he supposes to be produced by the mingling and collision of two atmospheric currents near the outer border of the trade winds; namely, the superior or equatorial stream, and the polar stream, which constitutes the trades. On looking at the curves representing the paths of the hurricanes on the charts projected by Mr. Redfield and Colonel Reid, it is difficult not to believe that the direction of their progressive motion is mainly determined by the configuration of the American continent.

The fact of the whirling character of storms has been controverted by Mr. Espy, another American writer on the subject, who advocates Franklin's theory of progressive motion in radial lines. Mr. Espy states, that on comparing simultaneous observations in the middle of storms and all round their borders, he found that the wind blows *inward* on all sides of a storm towards the central parts—towards a point, if the storm be round; and if oblong, towards a line extending through its greatest diameter; and that he had traced the effects of seventeen storms, without finding a single exception to the general rule. Professor Bache, of Philadelphia, maintains the same opinion; and has described a tornado which occurred at New Brunswick in 1835, in which he could find no proof of rotation, the objects thrown down by the wind being all directed to a centre. It is not improbable that there may be hurricanes of both characters. An outline of Mr. Espy's theory is given in the *Report of the British Association for 1840*.

Independently of the interest attached to the subject in a meteorological point of view, a knowledge of the general laws which regulate the phenomena of storms would be of immense importance, inasmuch as it would enable the navigator to avoid those tracts of the ocean in which they chiefly prevail at particular seasons, or at least, if surprised by a storm, to steer on the course by which he may soonest escape from it, or fall into its wake. On either theory the direction of the wind at the commencement of the gale must indicate, with considerable certainty, the quarter where the storm is raging with greatest fury.

TANNING.

THE following is the substance of a report recently presented to the *Société d'Encouragement*, at Paris, by the Committee of chemical arts, on certain improvements in tanning, effected by M. Vauquelin.

"The art of tanning constitutes a branch of industry of which every one appreciates the importance, but in which, nevertheless, but little progress has been made for some years past. The skins when cleansed are usually thrown into lime water, which facilitates the depilatory process, and then into larger vessels, where they are submitted to the action of the bark in a diluted, and more or less acidulated state. The tanning process may be said to commence here, and it is finished in the tan pits, where the skins are exposed for months, and even for entire years to the slow action of the tan, which is supplied by the bark of the oak, employed in its natural state, and interlaid, bed by bed, with the skins. It will be seen from this that tanning is a very tedious process, requiring the employment of large capital, and exposed to fluctuating chances; for it is difficult to foresee at what price an article will sell when it is necessary to purchase the materials which compose it two years before it is sent to market.

"Amongst the different specimens of improvements in this art produced at the last exhibition of the society, a skin was shown by M. Vauquelin, of which the judges entertained so favorable an opinion that the society resolved to assist the inventor in the experiments in which he was engaged, and which he would have found some difficulty in following up unaided. Owing to the support thus liberally afforded him, M. Vauquelin has been enabled to bring his experiments to a favorable conclusion, and to operate on a sufficient quantity of skins to afford the society the necessary data to form a correct estimate of the value of the process. The object which M. Vauquelin had in view was to substitute for the loss of interest in money, occasioned by the tediousness of the process at present in use, an expenditure of power borrowed from some natural and economical principle. The society will readily believe that its committee would not recommend it to sanction, by its approval, a revolution in recognised theories such as this, without having previously bestowed upon the subject the most careful and scrupulous examination. If the process of M. Vauquelin be brought into use, its value will speedily be tested. Should they be successful, tanneries, like paper manufactories, will be removed from the towns and established near water-courses and forests, so as that advantage may easily be taken of the natural and economical motive principle afforded by the former, and of the plentiful supply of bark furnished by the latter. So long as the tanning process is effected slowly; as at present, it will constitute in itself nothing more than a branch of commerce, where the management of capital will form the principal consideration, and the industrial part of the question will be in some degree lost sight of. Tanneries will continue to be established in the towns, so as to be close to the slaughtering houses whence the skins are to be had, and they will be monopolised by those who have capital at command. Suppose, on the contrary, that capital should become of minor importance, and that the commercial chances are reduced to something like certainty by the increased rapidity of manufacture, the skins, instead of being the

centre of attraction, will be sent to a distance from the towns to the places where economical manufacturing power, and a cheap and abundant supply of bark are to be had.

"The necessity of caution is therefore obvious, where an alteration is a question which threatens to subvert the entire economy of so considerable a branch of industry, and your committee have considered it their duty to submit to the society such doubts, as a close examination of the subject has suggested to them. In doing this, the committee are, at the same time, bound to convey to the society the favorable opinion which they entertain of the process of M. Vauquelin. The following is a description of the apparatus of which he makes use.

"1.—A species of milling machine, of which the stock becomes displaced by an advancing and retreating movement, which successively draws the skins under the hammers of the machine, and which prevents the movement from reaching the same portion of the skin more than once, which would have the effect of injuring its quality by heating it. The hammers are armed with round knobs, which have the effect of thoroughly manipulating the leather.

"2.—A large vessel, traversed by an axle, furnished with long spokes, or arms, which, turning on the axle, raise the skins lying in the tub, renew their contact with the liquid, and thus favor the absorption of the re-active power which the liquid possesses. These vessels serve to cleanse the skins, and form a substitute for the stoves usually applied to this purpose; it is also used in the tanning process, the skins being submitted in it to the action of concentrated bark in dilution.

"3.—A machine, which has some resemblance to a shears, and which is used for stripping from the skin the parts which it may be necessary to remove, which is ordinarily effected by the hand with a currier's knife; this machine is intended to prepare the skin for the operations of the currier.

"Without assuming that, in all respects, the processes of M. Vauquelin can lay claim to novelty, your committee, nevertheless, view the *ensemble* with lively interest. They are not ignorant, and it is their duty to state the fact, that M. M. Ogereau and Sterlingue have severally obtained interesting results, as regards the acceleration of the tanning process; they reserve, however, a more detailed notice of their improvements, until these talented gentlemen think proper to bring them before the public. As regards M. Vauquelin and his process, the following facts may be said to sum up the experiments on which your committee found their opinion.

"1.—A skin, presented to the exhibition of 1840, and preserved in a loft to which the sun and air had free access, after exposure for nearly two years to both, underwent no sensible alteration, and, when dressed, sustained a favorable comparison with new skins.

"2.—The skins prepared under the inspection of your committee have stood the test of use, and been found equal in all respects to those prepared by the ordinary process.

"3.—A considerable number of the skins brought from the coast of Africa, which were not in a state to be worked by any tanner according to the ordinary process, have been tanned with the greatest facility by that of M. Vauquelin, to the great astonishment of every tanner in Paris.

"Your committee does not hesitate to pronounce the question relative to the possible introduction of

mechanical processes in the act of tanning, as solved by the invention of M. Vauquelin. Considered as scientific experiments, the results obtained by the author are most important, and appear to leave no doubt on his mind as to their being calculated for general application. Leaving aside the question of economy, for your committee have not such facts before them as would enable them to judge whether the expenditure of power that the new method requires will be above or below the loss of interest which the process at present in use renders unavoidable, your committee entertain no doubts of its advantages in an industrial point of view, though, regarding it in a commercial light, they are not quite so satisfied as to its results. In the mean time, and notwithstanding the reserve which they have imposed on themselves as regards this invention, your committee are of opinion that the society should grant to M. Vauquelin the highest recompense in their power to bestow. The zeal and perseverance of this *industriel*, and the sagacity which he has shown in the combination of his various processes, entitle him to this encouragement on the part of the society, and in readily according it to him, they will probably give birth to a branch of industry which will be fraught with important benefits to France."

CHEAPNESS OF RAILWAYS IN AMERICA.

THE extent of communication by railways in America is truly surprising. They cover the United States like the meshes of a net. About 7,000 miles of railing have already been made, or are in actual progress. This would be incredible in a country where capital is so valuable, were the railways laid out on the same expensive scale with ours. British railways have cost from £20,000 to £50,000 a mile. Those of America have not cost, on the average, including buildings and all requisite investment, more than £4,500 per mile, being from one-fourth to one-tenth of the expense of British railways; that is to say, a given sum of money expended in America has provided the benefit of railway communication to an extent of from five to ten times as great as an equal one in Great Britain. Although these lines were not originally laid out on a pre-arranged plan, yet the detached lines have gradually been connected, so as to form continuous routes of great extent—some of the companies owning different portions of connected lines have found it convenient to amalgamate. The route between Baltimore and Philadelphia consisted of four companies, on four parts of the line, which are now incorporated in one company, under a single board of management. One great chain of railroad, commencing at Portsmouth, in New Hampshire, extends across the United States to Pensacola, in Florida, a distance of 1,600 miles.—*Athenæum*.

NOVEL APPLICATIONS OF BITUMEN.

THE Parisian Bitumen Company have made a new application of this material, which promises to be of great service in engineering works. It consists in cementing large masses of rubble-stone with the bitumen in a liquid state, and this has been successfully and extensively practised on the works of the Upper Medway Navigation Company. The river is divided into levels by weirs and locks; some of the former are of squared masonry, but others are less

expensively constructed, by throwing in the rubble-stone of the country to the desired shape and height of the weir; the bitumen is then melted and run in between the stones, and the whole forms a mass of such solidity as to resist the heaviest floods; it is impervious to water in every part, and it is supposed it will not require one-tenth of the repairs usually bestowed upon weirs of the ordinary construction.

The great advantages of the use of bitumen are cheapness and facility of construction: it may be employed in foundations of bridges and large buildings, as forming a compact body capable of resisting any pressure, bearing any weight, and becoming perfectly solid in five minutes after being laid; and it will effectually prevent vermin from getting into houses, or burrowing near the foundations. Among other novel uses of bitumen, are its employment for tessellated pavements of different colors, and ornamental floors of railway stations, churches, halls, &c.; it being equally durable with Yorkshire stone, much warmer to the feet, and not more than half the price of that material.

LAWS OF GARDENS.

THE few following remarks may prove beneficial to some of our numerous readers, and perchance save them many useless and unpleasant differences either as landlords or outgoing and incoming tenants:—Annual roots and flowers planted in a garden may be removed by any tenant, and so may young fruit-trees and shrubs in the garden or nursery of a person to whom the same has been let for the purpose of sale or trade.—2 *East's Reports*, p. 88. But unless a garden, or orchard, or other land, has been so let as nursery ground, no tenant can, as between him and the landlord, remove any flower, root, tree, or shrub, not strictly an annual, or not usually taken up at one season of the year and replanted at another; and if without authority he should remove the same, he would be liable to an action for the waste. And if a tenant, of any description, has made strawberry beds, he cannot, either before or at the expiration of his tenancy, and whilst they are likely to continue productive, remove or destroy the same, without being liable to an action for injury to the landlord or succeeding tenant.—1 *Campbell's Reports*, p. 227.

MEMORANDA.

Cloth Boats.—Some experiments have been made in France with portable cloth boats, the invention of a *Sieur Leclerc*. A flotilla of five of these little vessels, carrying twenty-eight persons, passed from the port of La Rapée to Saint Cloud, without accident; and the five boats were taken back by one man in a small hand cart. During the transit they were several times brought to the bank, and lifted out of the water, taken to pieces, put together again, and re-launched in less than five minutes.

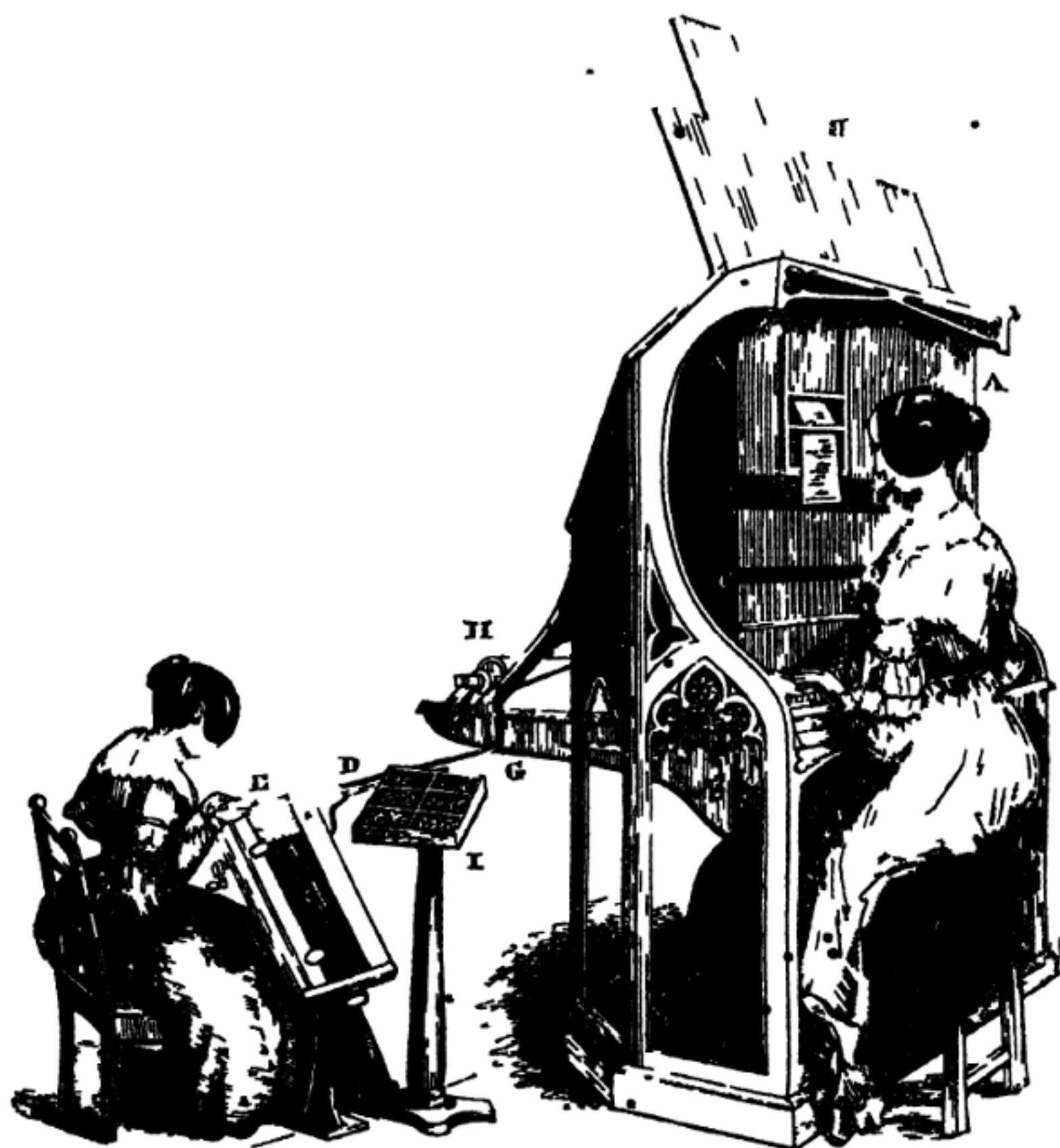
Nitrate of Soda, which is now extensively used as a manure, is often adulterated with common salt, which does not cost one-tenth of the price. To detect the adulteration, throw a small quantity of the article into the fire; if it contain salt, it will produce a crackling noise; if pure, it will melt rapidly, with a low hissing sound.

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NEW EDITION

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YOUNG'S COMPOSING MACHINE.

YOUNG'S COMPOSING MACHINE.

IN an age like this, where the whole population do, or may receive the benefits of education, and when literature so powerfully aids the desire of knowledge by its abundance and its cheapness—everything connected with the art of printing is of moment, not merely to the author, the printer, and the bookseller, but to the public, who are the consumers. Before the discovery of printing we know that books were almost unknown; two or three were a nobleman's greatest possessions, and a single volume was, in the dark ages, considered a sufficient pledge for an earl's ransom. The printing from wooden blocks was the first great achievement in the distribution of knowledge. The formation and use of moveable metallic types the second. With these inventions knowledge spread far and wide, and the dark and ignorant times of the Edwards and the early Henries gave way to the enlightened ages of Elizabeth, James, and Anne. The treasures of classical knowledge were unfolded to the public gaze, while what little was known on art and science, hitherto locked up in the recesses of the convent, became public property. Even newspapers and other vehicles of general information on passing events were not wanting to instruct the populace. Our own time has witnessed changes almost as important; the printing machine has produced the gigantic newspapers of the present day. Years ago, before these came into use, *The Times* was not half the size it is at present, and under the old method of working by the hand printing press never could have become so—human strength, with the best press ever constructed, could not have pulled off as clear an impression from one side of such a sheet of paper, and even were it possible that this could be done, the delay of such a process would have at once set aside such an endeavour. At present, it can print 50,000 in a single day. There are also very numerous daily and weekly prints of equal or nearly equal numbers; were these printed by hand, the number could not be completed in time without the greatly increased expense of setting up a second copy; the price of these prints then, being so much enhanced, would not be purchasable by one quarter of their present subscribers, consequently would not pay their conductors, and therefore would not exist.

Young's composing machine we believe to be another of those great inventions which occasion a momentary revolution in a particular trade, but a permanent benefit to society. Compositors are alarmed lest it should injure their vocation, and this they believe it will do in two ways; first, that it will execute work cheaper; and secondly, that it will introduce women to do their work. The latter being the weaker argument we will answer first. The machine only professes to set up the type, and to offer facilities in justifying it. The correction of the proofs, the making it up into pages, and the locking into chases, must be afterwards performed as at present. Now, as the printer is aware, much of this is heavy work, and can be done only by men, and that work will be increased in quantity in exact proportion to the rapidity of the machine's action. The first fear of the compositor is no better founded; types are set up by this machine with infinitely great rapidity than by hand is quite true; but the machine is only adapted to one sized type, and for all works where a variety of type,

frequent change of measure, or very careful spacing is requisite, it is wholly inadequate; thus it cannot at any time interfere with dictionary work, ordinary tabular work, hand-bills, cards, nor in most instances with what are technically called *jobs*. We may be asked, For what then is it valuable? The answer is, newspapers and magazines, where rapidity of progress is of more moment than ornamental execution; it is equally adapted for novels and standard works. Could all such be reduced in expense even one quarter, the public and the compositor would equally benefit; the one would get publications cheaper, the other more work, for hundreds of books and prints would be published which the present unavoidable expense of producing prevents the appearance of.

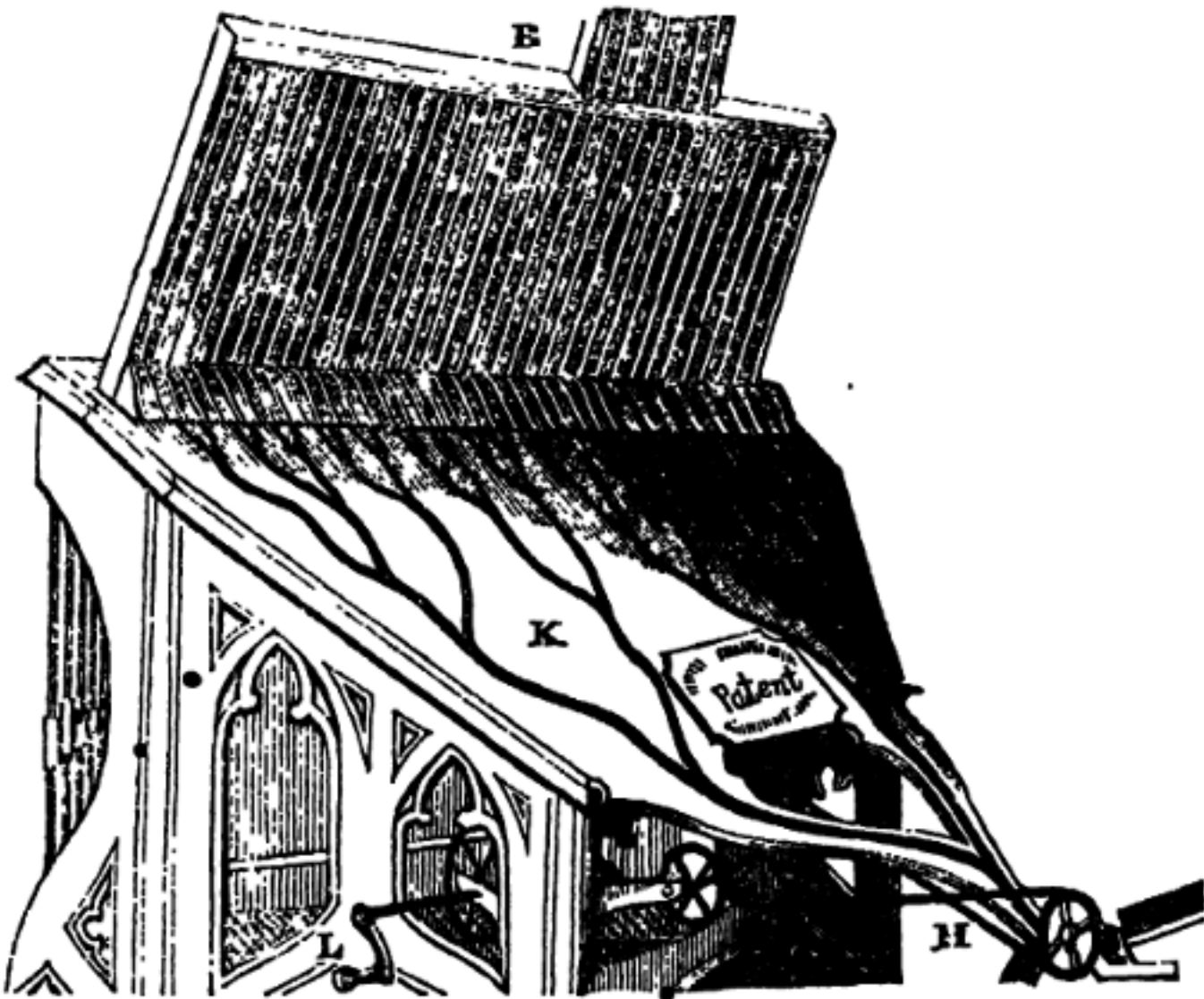
Remarks like these we are not in the habit of indulging in, but as a feeling of alarm exists on the subject, we have thought it advisable to wander a little out of our usual course. We apologise, therefore, to those who are not interested in these technical details, and having done so, will proceed to a description of the machine which called them forth, and of the process it is intended and well adapted to supersede. The compositor in a printing office stands before two cases, one placed above the other, and both supported upon a frame at a convenient height. These cases are called the upper case and the lower case, and are each divided into as many compartments as there are letters, stops, figures, spaces, &c., the upper holding the capitals, and the lower case the small letters. The compositor, previous to setting to work, takes in his left hand an instrument, called a composing stick; this he sets by means of a screw to any prescribed measure, according to the width of his work. He then having the copy before him, picks up the letters required in rotation, looking at every letter or type, to ascertain that it is the right end upwards, and also that the right part of the letter is towards the top of the stick, otherwise it might be upside down; at the end of each word he puts in one or more spaces, or blank types, taking care of the requisite stops as he proceeds. When a line is so far completed that he cannot get in another word or syllable, he introduces here and there other spaces, to make the whole measure complete in width, or until the line which he has set up fits tightly into the composing stick. He then begins a second line, and finishing that, a third, and proceeds thus slowly and cautiously, until the whole matter or copy is set up.

The composing machine originated, and has been perfected thus:—Mr. Young, who is a gentleman of great talents and property, has a young friend named Delcambre; talking upon the compositor's business, it suggested itself to them, that a machine might be constructed to supersede the manual labor required by the usual process. They immediately set to work with wood, pasteboard, and wire, and completed enough to convince them of the plausibility of the scheme; Mr. Young then came to England from Paris, that he might have the aid of an English engineer in working out his design. He fell in with Mr. Bessamer, then residing at Percival Street, Clerkenwell, a gentleman well acquainted with the printing and type-founding businesses; by his aid, the machine of Young and Delcambre's contrivance was completed, patented, and exhibited to the public last year. This machine was found, as most new inventions are, unnecessarily complex and incomplete. Mr. Young, therefore, immediately set about simplifying it, and the mind that could contrive was not slow in improving the

details which were at first defective, aided as it was by the mechanical superintendence of Mr. Wilson, the engineer, and thus the machine progressed to its present state of perfection and elegance.

Two views are given, the back and the front view; the same letters in the following description applying to both. A young lady sits in front of the instrument, which in size and somewhat in appearance resembles a cabinet piano-forte. The keys are engraved with all the letters, marks, and spaces required in printing, (72 in number). Communicating with the keys, and attached to them are a number of steel rods. Each of these rods is, at its upper end, connected with a small lever at the bottom of a long channel which holds a great number of those particular types that represent the letter marked on the corre-

sponding key. The whole series of channels for the types are shown at B in the cuts, and the connecting rods at A A. At the part marked C is a spiral spring upon each wire to restore it to its position, and to bring back the lever at top to its original place, when the pressure of the finger has been removed from the key. The back of the machine shows a number of channels or inclined planes, gradually uniting together until the whole 72 are blended into one. This single channel which is marked D is continued for about two feet, and terminates in a large fixed receiver or composing stick, as it may be called. The groove or channel of this composing stick, marked E, may be adjusted to measure by proper screws like the ordinary composing stick.



The action of the whole is beautifully simple, and consists of three parts:—1st. Arranging the letters. 2nd. Moving them forwards along the channel, and 3rd. Justifying them. A young lady having the copy hanging before her strikes the requisite keys of the instrument, and without any more trouble the exact arrangement of all the letters and spaces takes place, and with astonishing rapidity. (Of course it is supposed that the channels at the top B are previously filled with letter). Suppose the first word to be set up is "Young." The player touches the key Y; this pulls the appointed rod, which acting upon the lever at top, pushes the lowest letter of the channel Y a little sideways, over the orifice of the inclined plane appertaining to it. The letter descends and stops at the bottom of the single channel, at about the point G, or not quite so low as this. The keys of the letters o u n g are struck in rotation, and almost as rapidly as playing the notes of quick music, each letter placing itself upon the former, a blank succeeds, and then another word, and so on to completion. While this is doing, it is requisite that the types or words should be moved forwards along the horizontal channel D. This is done by the aid of a boy turning a winch at the side of the instrument; the winch puts in motion a series of wheelwork,

finally terminating in an eccentric, shown at H. This is in constant and very rapid motion, and catching each type as it arrives at the terminating channel on the lower part, urges it forwards. So perfect and admirable is the mechanical beauty of this eccentric, that however rapidly the types descend, they are never accidentally stopped or impeded, whether the eccentric be moved slowly or quickly; neither can the type by possibility be injured by the sudden propulsion it receives from the eccentric. We understand that Mr. Young intends to make this action dependent upon a treadle, worked by the player, and thus to spare the labor of the boy who at present turns the winch. The justifying the type is as easy and rapid as the setting of it up, and is performed thus:—The second young lady slips forward a quantity of type from the part of the channel D, until it arrives at E, the place to receive it. She separates the quantity of words or syllables required for a line of the composing stick from the rest, and then by a little contrivance attached to the stick, lets it fall the width of a type beneath the general surface of D. If it exactly and tightly fit the prescribed measure, that line is complete, and the next proceeded with in like manner; but as this is very rarely the case, she takes various little spaces or

blank letters from a box standing beside her, and in which they are arranged in sizes, and introduces them between the various words of the line, until the whole fits tightly, or as a printer would call it, is *justified*. The action of the machine is now complete, and the arrangement of the type in pages, &c., is conducted by usual processes. Two boys are employed in distributing the type when it has been used, and two others in keeping the channels supplied with letter.

After the above plain description, it is surely unnecessary to expatiate upon the beauty and efficacy of the instrument. He who cannot appreciate this without our assistance can have but a vague idea of mechanical excellence; and he who does not foresee the important results likely to arise to the community through its means can have but very cursorily regarded the world of literature, or the value of rapid and extensive information. Mr. Young may have prejudice and partial interests to contend with in the introduction of his machine, but we know that this will not damp his future energies. All great inventions are alike subject to these discouragements, yet in all cases of real value they are but temporary; public utility and trade competition will demand a fair trial, and we trust hereafter that Mr. Young's machine will be united in public estimation with the printing machine, the Jacquard loom, the spinning jenny, and others of the same high standing.

ANALYSIS OF THE WATERS OF THE AFRICAN COAST AND RIVERS.

THE Lords of the Admiralty lately transmitted to Prof. Daniell, of King's College, eight bottles of water taken up in the rivers and on the coast of Africa, with a request that he would analyse them, and report as to their effects on the copper sheathing of ships, of which they were found to be especially destructive; when some very curious and unexpected results came out incidentally, tending to show the probable cause of the miasma which has such destructive influence on that coast. "The most remarkable circumstance," says Professor Daniell, "disclosed by the analysis of these waters, is the strong impregnation of the majority of them with sulphuretted hydrogen; which, in the case of the water from Lopez Bay, amounts to almost as much per gallon as in the Harrowgate waters. The proportions of the saline contents do not differ materially from those which are usually found in sea-water. The extraordinary presence of this gas would naturally lead at first to a suspicion that it might arise from some change which had taken place in the waters after they had been bottled, from the decomposition of some animal or vegetable substance; but this suspicion is inconsistent with facts. On the other hand, it is difficult to conceive how such a striking and important fact as the impregnation of the waters of the ocean, upon such a long line of coast, with this deleterious gas, could so long have escaped observation. It is highly desirable, in many points of view, that its existence should be substantiated, and the limits of the phenomenon, both along the coast and in the ocean, ascertained by further evidence. Its effects upon the copper sheathing of ships cannot fail to be highly injurious; and a question of still higher interest even arises—whether this deleterious gas may not contribute to the well-known unhealthiness of the coasts from which these waters are taken.

"Upon searching for evidence of a similar phenomenon having been observed before, I have found, in the *Philosophical Transactions* for 1839, a memoir by the late Dr. Marcet, 'on the specific gravity and temperature of sea-waters, in different parts of the ocean, and in particular seas, with some account of their saline contents.' Out of sixteen specimens which he examined, he found one which was brought by Captain Hall from the Yellow Sea, in the Chinese Ocean, which, from the account which he has given, must probably have been as highly charged with sulphuretted hydrogen as those which I have just examined from the coast of Africa; and he observes, 'there is something in the development of sulphur in sea-water which is by no means well understood.' He also noticed, that a specimen brought by Mr. Schmidtmeier, going to South America, from latitude $10^{\circ}50'$ north, longitude $24^{\circ}26'$ west, had an hepatic smell, and had blackened the bottle in which it was contained. If the existence of this curious phenomenon should be confirmed, the origin of the sulphuretted hydrogen will probably be found to be the same as that of the same gas in various saline lakes in different parts of the world, from which trona or natron is derived. The mud of the Lonar Lake in India, of a lake near Maracaybo, in South America, and of similar lakes on the north of Africa, are all found to be thus impregnated. The sulphuretted hydrogen thus adhering to the clay, has been supposed to be derived from volcanic sources; but Mr. Mulcolmon, in an able memoir lately printed in the *Geological Transactions*, says, that he has observed 'the same phenomena in the salt-water inlets along the Indian coast, wherever the bottom contained argillaceous and carbonaceous matter;' and he ascribes the effect to the decomposition of the sulphates in the water by the carbon, and the clay only prevents its passing off into the air, or mixing with the water, by the power of adhesion. The subject is full of interest, both in a practical and scientific point of view, and well worthy of investigation."

In a subsequent Report on additional specimens, Professor Daniell observes:—"It is impossible not to speculate upon the origin of the deleterious gas which has now been proved to impregnate the waters of the western coast of Africa, in such enormous quantities, through an extent of more than sixteen degrees of latitude. It appears to me, that there are only two sources to which it can with any probability be referred, namely, submarine volcanic action, in which case its evolution might be considered direct or primary; and the reaction of vegetable matter upon the saline contents of the water, in which case it would be secondary. The probability of a volcanic origin is, I think, small, from the absence, I believe, of any other indications of volcanic action, and from the great extent of the coast along which it has been traced. What is known of the action of vegetable matter upon the sulphates, and the immense quantities of vegetable matter which must be brought by the rivers within the influence of the saline matter of the sea, renders, on the contrary, the second origin extremely probable. Decaying vegetable matter abstracts the oxygen from sulphate of soda, and a sulphuret of sodium is formed. This again acting upon water, decomposes it, and sulphuretted hydrogen is one of the products of the decomposition. You will perceive that there is a large proportion of the sulphates in the different specimens of water which

have been analysed; and there can be but little doubt, I imagine, that extensive mud banks must be formed at the mouths of most of the rivers on the western coast of Africa, within the tropics, consisting chiefly of vegetable detritus in the exact state which is most favorable to the action which I have described. This view rests upon experimental evidence, and upon considerations of great cogency, derived from the unhealthiness of certain well-known situations in which decaying matters from tropical vegetation are brought into contact with sea-water. I feel more than ever convinced, that the evolution of sulphuretted hydrogen is intimately connected with the unhealthiness of such stations.

"When this matter was first brought under my consideration, I was surprised that the nauseous smell which must necessarily be evolved from water impregnated with this gas, at so high a temperature as that of the equinoctial regions, had not been noticed. I have in consequence turned to some of the accounts of the late travels in Africa, to seek for evidence upon the subject; and in the narrative of an expedition into the interior of Africa, by the river Niger, by Macgregor Laird, and R. A. B. Oldfield, I found the following important observations: 'The principal predisposing causes of the awful mortality, were, in my opinion, the sudden change from the open sea to a narrow and winding river, the want of the sea-breeze, and the prevalence of the deadly miasma, to which we were nightly exposed from the surrounding swamps. *The horrid sickening stench* of this miasma must be experienced to be conceived; no description of it can convey to the mind the wretched sensation that is felt before and after day-break. In those accursed swamps, one is oppressed not only bodily, but mentally, with an indescribable feeling of heaviness, languor, nausea, and disgust, which require a considerable effort to shake off.' Now, these observations were made in the very locality from which some of the first waters which I examined were taken, and nothing more is wanting to identify the cause of the rapid decay of ships' copper with that of the mortality of the climate. It has been experimentally found, that so small a mixture as a fifteen-hundredth part of sulphuretted hydrogen in the atmosphere, acts as a direct poison upon small animals; and the sensations of languor and nausea, described by Mr. Laird, are exactly those which have been experienced by persons who have been exposed to the deleterious influence in small quantities. The peculiar unhealthiness of mangrove swamps in all parts of the world, I have little doubt, arises from that tree requiring salt water for its growth, and its decaying foliage being thus brought into immediate contact with the sulphates. The hypothesis also agrees with the fact, (which, I believe, has been established) that the unhealthiness of such situations does not extend to any considerable distance from the sea."

MINIATURE PAINTING. *

(Resumed from page 91, and concluded.)

Of Colors proper for Men's Draperies.—We shall, under this head, make some general observations; the first of which is, that in all cloth draperies for men's portraits, it is necessary to add some flake white; as it not only gives the color the dead appearance which cloth exhibits, but likewise its being incorporated with the flake white, gives it a body which makes the flesh tints appear to more advan-

tage. The next observation is, that in grinding up your draperies, you are to make them appear several degrees lighter in color than you want them to be when dry, for this reason; the flake white is a color so very heavy, that, after you float in your coat, it will sink to the bottom, and leave your colors several degrees darker than when it was wet; and finally, you are not to be too heavy or thick in floating in your draperies, but merely to see that your color is evenly spread over the part.

There are four modes of working in miniature painting; namely, floating, washing in, handling, and marking. The first process, which is floating, and is chiefly used for draperies, is thus performed: Having marked with your pencil where your drapery is to be, grind up your color on your flag (not putting a quantity of gum water, that would make it shine, as it would frustrate your purpose); then take a large soft hair pencil, and, having previously laid your ivory on a very level table, fill your pencil plentifully with the color, and lay it quick all over the parts of the ivory you want covered, seeing that it runs on every part equally, which, if kept in a proper fluid state, it will readily do; then lay it in some place to dry, where it is not likely to receive dust, when you will have a fine level surface ready to work the shadows of your drapery on in a couple of hours. Washing in is performed when your picture is on your desk, by filling your pencil moderately with color, and giving a very broad stroke rather faintly, as the contrary would not answer: this manner is chiefly used in beginning the lesser back grounds, and likewise in laying on the general flesh tint of the face. It is also used in the first touches of the dark shadows, which ought to be begun faint and broad. Handling is the manner in which all the fleshy parts of the miniature must be worked, after the first washing in; and lastly, marking consists in the sharp spirited touches given to the features, in order to give that animated appearance so necessary to constitute a fine picture.

Black drapery is formed of lamp-black burnt, and flake white; and must be laid in with a good deal of the latter, as otherwise it would be very difficult to manage the shadows so as to produce a pleasing effect.

Blue drapery may be made of either Prussian blue or Antwerp blue, mixed with white; indigo being too much inclined to a blackish cast.

Green drapery is well made of king's yellow and Prussian and Antwerp blue. The more blue, the darker the green; and the more yellow the contrary.

Yellow drapery cannot be so well represented by any color as king's yellow, laid thin, with a moderate quantity of gum in it.

Drab color is well represented by a judicious mixture of umber in its raw state, and flake white.

A queen's brow, as it is called, is made of burnt Roman ochre, a little lamp-black and lake, with flake white amongst it.

Claret color may be well represented by a mixture of Terra de Cassel, a little lamp-black and lake. The more black and lake the deeper the color.

Dark brown can be formed by a junction of Nottingham ochre, lake and lamp-black.

Lilac is made of carmine, Prussian blue and flake white.

Grey can be formed only of lamp-black, flake white, and the smallest quantity of lake laid in very thin.

Reddish brown is best made of Indian red, very little lamp-black, and flake white.

Scarlet is a color very difficult to lay down rules for making, as in some pictures it is dangerous to make it too bright, for fear of hurting the effect of the face, by its brilliancy catching the eye too readily; consequently, if the subject you are painting from life is very pale, you run a very great risk by annexing a very bright scarlet to his picture. We shall, therefore, only mention that a very bright scarlet is made of Chinese vermilion and carmine, ground together without any flake and white; and if you want it still rendered brighter, when it is dry, fill your pencil with plain carmine, mixed with thin gum water, and glaze over it nicely; but if, on the contrary, you wish to sadden or take away a share of its brilliancy, add a little flake white to it, and that will have the desired effect.

Of painting the face.—You are first to provide yourself with a mahogany desk for painting on, which is a box about fourteen inches high, and a foot broad on the top; there is to be a lid covered with green cloth, which is to have a pair of small hinges at the front, and to lift occasionally with a supporting rail at the back, and notches, so as readily to adjust it to any height. About the middle of the green cloth there is to be a slip of very thin mahogany, glued at each end, but the centre of it left free, to fasten your ivory by, slipping it between the mahogany and green cloth.

The next thing you are to observe, is the choice of your light which in this kind of painting cannot be too particularly attended to; it not being like oil-painting, where the rays of the sun may be kept out by blinds, &c. without causing any material inconvenience. A north light, or as nearly as possible to it, must be attained. If there are more than one window in the room, the second must be closed, so as to admit no light; and the one you sit at is to have a green baize curtain against the lower part of it, to reach about a foot higher than your head, as you sit at your painting desk, with your left towards the light.

Having placed your sitter at the distance of about a yard and a half from you, begin drawing the outlines of the face; and in this be very particular, as much depends on it. When you have them drawn correctly begin to lay in the color, faintly, of the iris of the eye, the shadows under the eye-brows in a grey tint, and under the nose rather a warm purple, in broad faint washes: ever keeping this in your mind, that you must, in the process of painting the face of a miniature picture, go on faintly at the beginning, and not hurry in your colors, as such conduct will, to a certainty, make your tints look dirty, and your picture harsh and disagreeable. Having, as before observed, laid in your grey tints where your shadows are to fall, go on heightening them by degrees, working in hatches with a middling full pencil, not too washy, nor too dry; as the former would have been the means of muddying your colors, and the latter would make them raw. When you think you have pretty strongly marked out, and worked up the shadows, mix a wash of either gall-stone, or Nottingham ochre, and drop lake, with which faintly go over the fleshy parts of the face, where the shadows do not come; and then proceed to heighten carnations on the cheeks, the color of the beard, if any such appears, still working in the huddling manner already mentioned, in various directions; so that, after some time working, the intersections appear like so many nice points or dots. Observe, as a general rule, that it is much easier to warm the tints of your face, than to cool

them, by working proper colors over it. It is therefore best to begin with cool greys and purples, and towards the finishing of the picture, to add warmth, if necessary by gradually working such colors as gall-stone, terra Sienna, or the like, over, in addition to the carmine or lake that may be necessary to produce the tint of nature.

From the variety of style adopted by different miniature painters, it is very difficult for a young beginner to ascertain which is best to be followed; and as there is a certain degree of mechanical attention to be paid to the management of the water colors, to preserve them clear and free from muddiness, which is difficult to attain, we recommend to the young artist to procure a good miniature, if possible, and keep it by him, observing the style of penciling, and management of the color, at the same time letting nature be his guide in the making of his features and coloring of his picture.

In the management of back-grounds, the young painter is to observe their two-fold purpose: that of giving the lights their proper value; and on the other hand of harmonizing the colors of the face, by artfully engaging the eye with somewhat of similitude in the back ground to a tint in the face, which otherwise, in course of working to express a particular part, might appear too prevalent.

In painting a head on an oval piece of ivory, such as the present form of a miniature picture, draw the chin as nearly as possible in the centre of the ivory, unless the person is very tall, in which case it must be higher up; and if very short, the contrary.

REMARKS ON ELECTRICITY.

(To the Editor.)

SIR,—In transmitting to you the following considerations on electricity and its kindred studies, for insertion in your Magazine, I am anxious that they should not be looked upon as intended to form anything like a complete dissertation upon the present state of that science; by far too extensive and interesting a subject to be thus hastily dealt with, or in fact capable of being so treated with any pretensions to accuracy. On the contrary, it will be my object to pass over in rapid review all the various divisions of the science.

Who would imagine that such a science as electricity, by which we are now able to explain the cause of the lightning-flash or the thunder-clap, could ever have arisen from merely observing and reasoning upon the simple fact that amber, glass, and certain other bodies acquire the peculiar property, when excited by friction, of attracting or repelling light bodies brought within their neighbourhood? Or who would ever have supposed, had he witnessed Galvani in his laboratory, pondering over the spasmodic twitchings of a frog's leg, that that philosopher was then laying the foundation of a science, destined eventually to explain the cause of the direction of the magnetic-needle?

On looking back upon such occurrences as these, followed as they have been by such unexpected results, each of us is naturally led to consider how improbable it is that he will ever become either the Galvani or the Oersted of future ages. But since such a supposition by no means amounts to an actual impossibility, allow me to remind such an one, that it is a duty incumbent upon almost every

one of us, to strive as far as lies in our power with the opportunities we may respectively possess, to add no matter how small a tribute to the advancement of the objects of science. For let us never forget, it is only by a thorough acquaintance with, and careful accumulation of the causes of isolated and simple facts, that we can ever hope to be able to render a correct rationale of those which have become more complicated from attendance and circumstances.

I shall take it for granted therefore, that my readers are perfectly conversant with the few technical terms which I may be obliged to make use of in the subsequent observations. This will greatly facilitate my work, and make it, I trust, not less acceptable or intelligible to many of them, particularly so, as I shall endeavour to make my explanations as familiar as the nature of the subjects will permit.

In the first place, I think I need hardly hesitate to assert, that all electrical phenomena depend more or less on the existence of a certain something, which for the sake of convenience, is designated the electric fluid. Now I doubt not there are many persons who would immediately propose the question;—(On what grounds do you assert that it really is a fluid? In reply to this somewhat difficult question, I think I may venture to observe, (without entering into any unnecessary or elaborate investigation of the importance or relative value of the various theories and opinions which have been from time to time propounded on this point,) that the only way in which we support such an assertion is by somewhat the following train of reasoning.

We are well aware that matter is presented to us in but three different forms, namely, the solid, fluid, and gaseous. Now there is hardly any simple body known to chemists, which, although it may usually assume but one of the three states here mentioned, is not capable under certain circumstances of appearing in one or both of the remaining two. I need not mention for example that there are certain metals, such as zinc, which at the usual temperature of our atmosphere, are found in the solid form, but by a slight increase of temperature become fluid; and at a still higher one may be distilled over in the gaseous or rather vaporous state. Water again is a familiar illustration of the second form;—at the usual temperature it is fluid,—at a higher temperature it passes off as vapor or steam—and by diminution of heat it becomes solid or ice. Carbonic acid will serve to exemplify the third state of matter; as we usually find it, it is a gas. By the application of cold, while under enormous pressure, it assumes the fluid form, and by continuance of the same process it may be rendered perfectly solid. Hence we perceive quite clearly that there are but three forms under which matter can exist. We have, therefore, only to decide which of these this agent is most likely to assume, and whether it is capable under certain circumstances of changing its state at different times. That it is not the solid form, I think the term itself, and the characters and properties which we so naturally associate with it, sufficiently prove; more especially so if we consider for a moment its rapid progress through conducting bodies in general, under whichever condition it may make its appearance. We have now to consider between the fluid and gaseous states—whether it is most probably a fluid or a gas.

With regard to this final part of the question, it is difficult to give any thing like a satisfactory answer;

the difficulty entirely arising from the very fact that we are here discussing the existence of an agent, which, like many others in nature, we know alone by its effects. Common consent has, however, so decidedly stamped upon it the fluid form, that I think we cannot do better for the present than admit such to be case. Still we must remember that the whole reasoning is purely hypothetical; we start by supposing it to be a fluid, and if during a series of careful observations of its effects we do not detect any thing exactly repugnant to such an idea, I think we are quite justified in retaining it. All I would insist upon is, that if we contend for the materiality of that agent, whose presence we regard as the constant cause of all electrical phenomena, and admit that matter is only capable, (as far as our present knowledge teaches us,) of assuming the three states before noticed, we must conclude that of all these the fluid is the most likely one in which it may exist. At least it is the one in accordance with which we can most easily explain the greatest number of the phenomena which come under our consideration.

Still there are many philosophers who, with very great show of reason, assert the existence of *two* fluids, essential to the explanation of these phenomena, both equally subtile, elastic, and universally diffused, and each highly repulsive as to its own particles, and attractive of those of the opposite kind. As this is by no means the most generally-received opinion, I shall not pause to enter into any consideration of its probable correctness at present, but content myself with remarking that there is hardly any experiment the cause of which cannot be explained as easily, and almost as satisfactorily by either of these theories. I think, however, we shall find the former far preferable, when we come to speak of galvanism and electro-magnetism, and for this reason I shall adopt it. I will begin with common electricity—that form which is developed by the common electrical machine, and called the electricity of tension. Let us admit for the sake of conciseness that it presents three prominent phenomena, which may be considered essentially characteristic of its presence, viz.: the shock, the spark, and its power of effecting chemical decomposition. Now if we compare these with its effects when it appears under its milder form, as electricity in motion developed by the galvanic battery, we shall find the greatest possible similarity between them. Here we have also the shock, the spark, and the power of effecting chemical decomposition; so much so that we might at first be almost inclined to suppose that we should find some difficulty in distinguishing between them. But upon more attentive examination we soon discover that such is not really the case; in the former we have the fluid in its greatest intensity, and its effects, although extremely powerful, last but for a moment. In the latter, however, it can hardly be said to possess so much energy, but it passes off in such enormous quantities, that it makes up by long continuance for what it is deficient of in actual force. This property is of the greatest value, as it gives us an opportunity of observing carefully its various effects, and studying the laws by which it is influenced—a matter of no small difficulty, and frequently totally impracticable, when they are performed with such amazing rapidity.

It is by watching it when under this milder and more tractable form, that we learn the identity of the electric and magnetic fluids. Let us proceed to treat this part of our subject in the same manner as we have the preceding, allowing that the properties

characteristic of the presence of magnetism are the following:—A powerful attraction for fragments and small particles of iron or steel; a disposition in bars under its influence to arrange themselves directly in the magnetic meridian; and a mutual repulsion between like poles, and attraction among those of an opposite kind. We shall then discover that each of these effects may be produced as effectually by compelling a current of electricity to pass in certain directions around iron or steel bars.

Hence there is little difficulty in imagining, in accordance with Ampère's most beautiful theory, that the only difference between a magnetised bar, and a piece of common iron of the same dimensions, is, that the former has constantly circulating around it currents of electricity, at every part of their course at right angles with its surface; a peculiarity which is wanting in the latter. This we may prove by direct experiment; for if we take this second piece of iron, and wind around it a portion of covered copper-wire of any convenient length, and pass along it a current of electricity, we shall perceive that as long as it continues to flow in the same direction, so long will the bar which it surrounds possess the properties of a permanent magnet.

Now if we remove the iron, and leave only the coil of wire, which will be in the shape of what is termed a helix, and suspend it so as to be free to move, (as exemplified in De la Rive's floating battery,) it will arrange itself due north and south during the time that the current of electricity is passing through it, and be attracted and repelled precisely in the same manner as if it really contained the iron bar. Thus, we perceive, that magnetism is perfectly independent of any inherent property possessed by iron; since we can produce it in an apparatus, not containing the slightest portion of that metal; but that it essentially depends upon the wonderful, and, at present, inexplicable fact, that currents of electricity, when flowing in certain directions, have a disposition to cling around iron in preference to other bodies. This is termed electro-magnetism; that is, magnetism derived from electricity. I feel assured it will be productive of much pleasure among those engaged in investigating such a science, to be informed that not only can all the effects of magnetism be performed by electricity, but all the essential phenomena of electricity can be produced from permanent magnets—hence, arises the study of magneto-electricity—electricity produced from magnetism, as found in permanent magnets. In one of the previous numbers of this Magazine* there is a very excellent description of a machine invented by Mr. Clarke, and known as Clarke's magneto-electrical machine, for illustrating the leading experiments of this study, by which a powerful shock, brilliant sparks, and the decomposition of water are readily produced. Fortunately for us we possess other and more delicate means of appreciating the existence of feeble currents of electricity, than those I before mentioned, under the general appellation of prominent phenomena. These are certain little instruments, called electroscopes and galvanoscopes; the one, as its name implies, intended for detecting common electricity—the other, electricity in motion. The first depends upon a well-known law, that bodies, when similarly electrified, repel each other; and the second is founded upon the important discovery of Oersted, that a

wire conducting a current of electricity causes a magnetic needle, placed either above or below it, to deviate from the magnetic-meridian a certain number of degrees, in proportion to the intensity of the current; from which it becomes at the same time both a galvanometer and a galvanoscope. It is by the assistance of this instrument that we are able to detect the existence of certain feeble currents, developed by what is termed thermo-electricity; which will next claim our attention, under the compound name which is occasionally applied to it of thermo-electro-magnetism. It can be demonstrated by experiment, that if bars of certain metals be arranged in a particular order, and heat and cold be applied alternately to their points of junction, a current of electricity will be developed, and pass invariably from the heated to the cooled extremity of each bar; which, although in its lowest state of intensity is capable while passing along a conducting wire, of deflecting the magnetic-needle, which is thus a test of its presence. This current is so feeble, that little has yet been done in investigating its effects beyond proving that it is identical with the galvanic, and consequently, the electric fluid. We look anxiously for experiments more convincing than those which have been already devised; as it is through it we hope to be able eventually to establish the identity between heat and electricity.

Allow me in conclusion, to suggest the following; that since we observe that this current flows constantly from the hot to the cold end of each bar, and that according to the most generally received theory of the transmission of heat along conducting bodies, (among which, the metals hold such a prominent place,) such would be its progress; we must either conclude, that at the same moment two distinct fluids are flowing in the same direction, or admit that they are identically the same.

With this I will close the foregoing remarks; which, if they have, in any way, amused or instructed their perusers, or have been the means of adding but one to the number of the lovers of science, have brought with them their own reward.

Faversham, Kent.

E. L.

MOUTH, OR INDIAN GLUE.

(To the Editor.)

SIR.—Perhaps the following receipt for making a useful kind of glue may be of use to you, or some of your readers:—

Take 1lb. of the best glue, the stronger the better, boil and strain it very clear; boil also 4 ounces of isinglass, put the mixture into a double glue-pot, add $\frac{1}{2}$ lb. of brown sugar, and boil the whole till it gets thick; then pour it into thin plates or moulds, and when cold you may cut and dry them in small pieces for the pocket. The glue is used by merely holding it over steam, or moistening it with the mouth. I have manufactured some myself, and find it a most useful and convenient article, being much stronger and more easily applied than common glue. It is the same, I believe, as that sold under the name of "Indian glue," but is much less expensive in making, and applicable to all manner of small fractures, &c.; answers well on the hardest wood, and cements china, &c., though, of course, it will not resist the action of hot water. For parchment and paper, in lieu of gum or paste, it will be also found equally convenient.

ATHON.

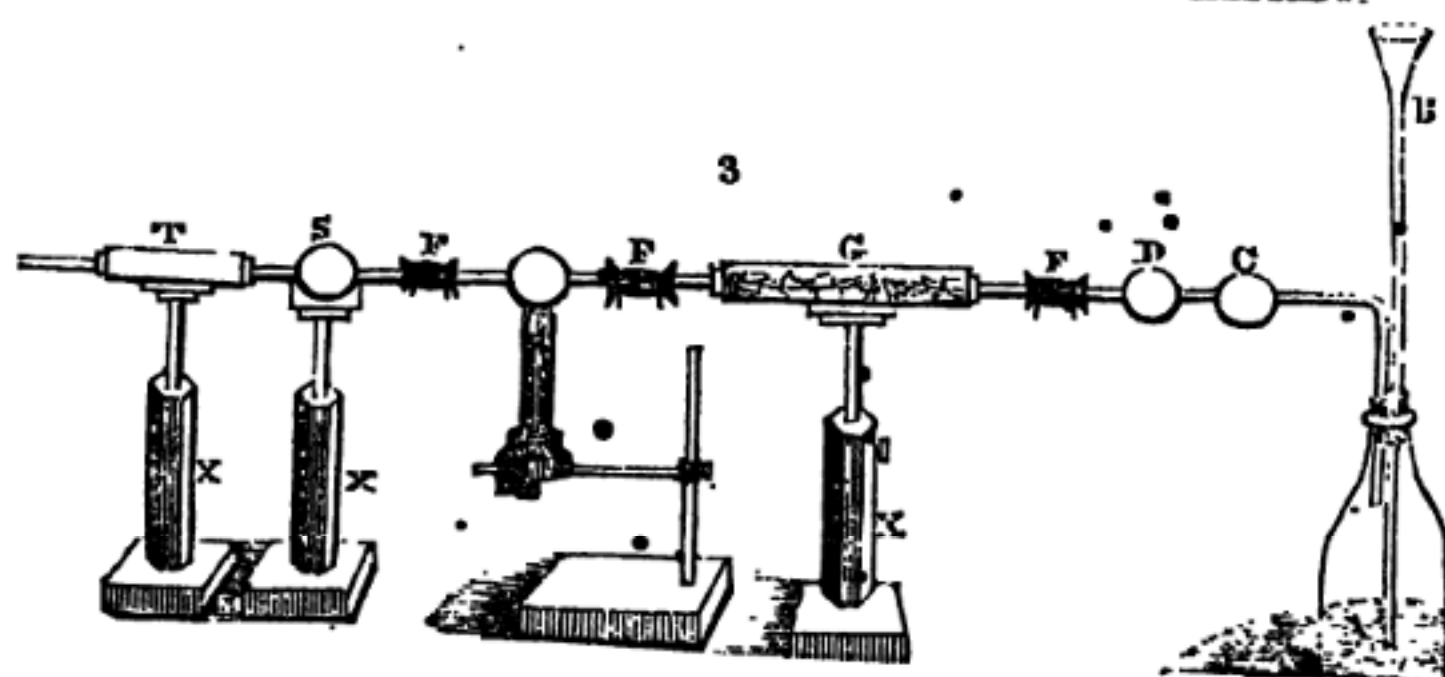
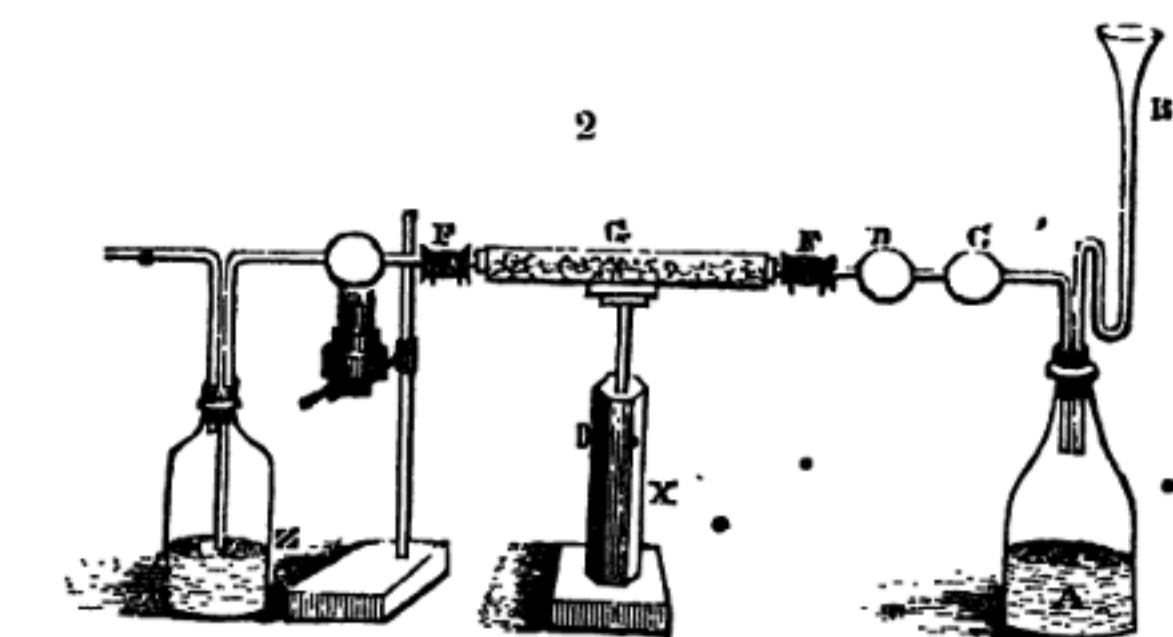
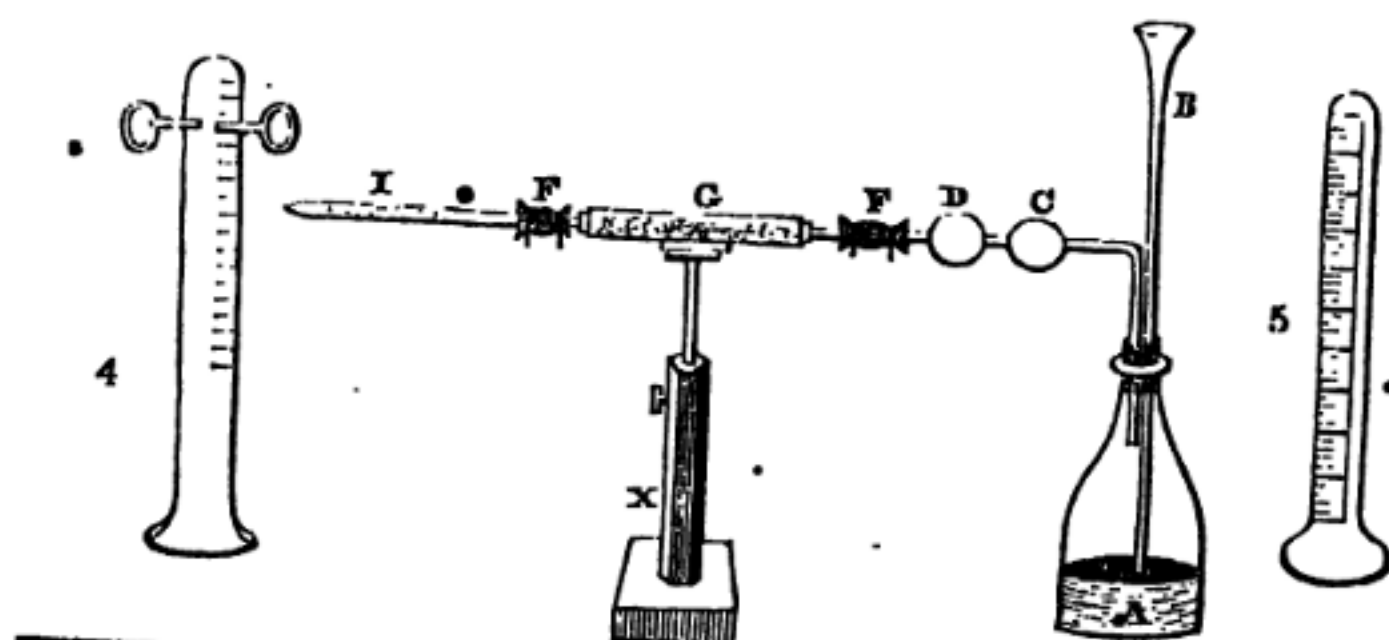
* See Vol. I, No. 33.

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APPARATUS FOR CHEMICAL ANALYSIS.

APPARATUS FOR CHEMICAL ANALYSIS.

For the greater number of analytical experiments on minerals very simple apparatus will be found sufficient. Tubes, flasks, and evaporating basins, bottles, precipitating glasses, filters, funnels, pipettes, a silver, a platinum, and porcelain crucible, each capable of containing from a quarter to half an ounce, small retorts and receivers, a balance, a pair of forceps, an agate mortar, and a strong spirit lamp, constitute all that is necessary. A blow-pipe and set of test-tubes are of great use, and the flat glass also may be advantageously employed in preliminary analysis. A separate apparatus is also very desirable for the preparation of sulphuretted hydrogen gas, which is much employed in analytical operations.

The three principal figures in the cut represent the usual disposition of apparatus employed in preparing, drying, and transmitting gaseous substances over any subject of experiment, when the apparatus requires much care and attention.

A represents bottles, flasks, or retorts for producing the gas required; B, a long funnel for introducing acid in small successive quantities, or any other liquid that may be required; C D, balls for intercepting any portion of fluid which may be mechanically suspended in the gas escaping from the bottle; E, the tube filled with fragments of chloride of calcium for drying the gas; F, caoutchouc connectors.

In Fig. 1, the gas is made to act upon I. The assay is often placed in tubes as G. Fig. 2 illustrates the arrangement adopted when a gas produced by the action of the assay, with the gas from A, is to be transmitted into water, a solution of potassa, or any other substance contained in the bottle Z. Fig. 3 represents a still more complicated arrangement, in which the product obtained, as in the preceding figure, is subjected to still farther operations, by the materials introduced at S or T.

A graduated tube is required in numerous experiments with gaseous substances, when mixed together and detonated by the electric spark, as shown in Fig. 4. Where the electric spark is not required, or the mercurial trough sufficiently large, the tube is often made of the form seen in Fig. 5.

As to the materials which are necessary in analytical chemistry, there are few which cannot be brought into operation in particular cases; the following, however, are those that are generally employed, and therefore the beginner cannot too carefully test their action upon each other, so as to be certain when a complicated mixture is used, when they act upon the substance to be tested, and when, on the other hand, their indications are merely the result of their action with each other.

Distilled water.	Benzoate of ammonia.
Sulphuric acid.	Succinate of ammonia.
Nitric acid.	Charcoal.
Muriatic acid.	Iron.
Gallic acid.	Copper.
Tartaric acid.	Zinc, tin.
Potassa.	Chlorine.
Soda.	Sulphuretted hydrogen gas.
Ammonia.	Alcohol.
Ferrocyanate of potassa.	Test papers.
Nitrate of potassa.	Sulphate of iron.
Iodide of potassium.	Acetate of lead.
Borax.	Sulphate of copper.
Phosphate of soda.	Nitrate of silver.
Oxalate of ammonia.	Bichloride of mercury.
Hydrosulphuret of amm.	Bichloride of platinum.
Muriate of ammonia.	Bichromate of potassa.

In studying the action of all the preceding substances upon each other, they should be mixed in

small successive quantities, one substance alone being mixed with another in the first instance, at natural temperatures, heat and water being applied afterwards according to circumstances.

In analytical chemistry it is a good general rule to presume that no test is pure, unless it has been carefully proved to be so.

Farther, all solutions that do not give any indication with the substances applied, should be examined when neutralised with much care, and also when rendered slightly acid or alkaline by any substance that does not cause a precipitate, and with various proportions of water.

ANIMALS AS PROGNOSTICATORS OF THE WEATHER.

Among quadrupeds, the following are believed to indicate, by their restlessness and peculiar actions, a foreknowledge of approaching changes of weather. When horses stretch forth their necks, neigh much, snuff the air with distended nostrils, and assemble in the corner of a field with their head to leeward, rain may be expected.

Sheep are seen running to and fro, jumping from the ground, and in their gambols apparently fighting, previously to a change of weather. Fine weather may be expected to continue when cattle lie in the open field, or in the courts instead of the sheds; when sheep take up their lair for the night on the brow of a knoll; when pigs lie down for the night without covering themselves up in litter. Bad weather is said to be prognosticated when asses hang their ears forward, or rub themselves against walls or trees. Swine also become uneasy, restless, grunting loudly, and return to their sties. Before rain, dogs are apt to grow very sleepy and dull, and to lie all day before the fire, showing a reluctance to food, except grass. When cats lose their vivacity, remaining within doors, wet or windy weather may be expected. Finally, when rats and mice are more than usually restless, forsaking the fields and ditches, approaching rain may be anticipated.

Fallow-deer, and many other animals, becoming restless from the uneasiness they feel owing to the altered condition of the atmosphere, prognosticate the approach of rain. If frogs croak more than usual—if toads issue from their retreats in great numbers—if earthworms come forth from their holes—if moles throw up the soil more than usual—if pigs shake and spoil the stalks of the corn—if oxen lick their forefeet, all these signs are said to indicate rain.

It may be remarked that, in summer, when sheep rise early in the morning it is a sure sign of either rain or a very hot day; and that in all seasons when they jump and play about it is a sign of rain or wind (but generally both) in the summer, and very stormy weather in winter.

In winter, when the sheep lie under a hedge, and seem loth to go off to pasture, and bleat, it is considered a sign of a storm.

When rabbits come out to feed early in the evening, it is a sign of rain in the night in summer, and of either rain or snow in winter; and when it is likely to be a bad night, they will be apt to return to their burrows before it is dark.

Next, with respect to birds: there is an old saying that "when swans fly it is a sign of rough weather," and the correctness of this saying would appear to be proved. A late writer states that he had invariably found that when the swan flies any

distance against the wind, however fine the weather may be at the time, so sure will a wind, almost amounting to a hurricane, arise within twenty-four, and generally twelve, hours after the bird has taken flight. The early appearance of woodcocks, snipes, fieldfares, and other birds of passage, &c., are prognostics of severe winters. When owls hoot and screech during bad weather, it is a sign of coming fine weather. The misseltoe thrush (*Turdus viscivorus*) frequently sings particularly long and loud before rain, and sometimes even during severe storms: hence it is termed the "storm cock." The blue macaw is said to be a true indicator of the changes of the weather. Dr. Thornton is stated to have had one some years ago, whose blue feathers assumed a greenish hue in rainy weather, or grey in clear weather, if likely to change for wet.

When cranes fly exceedingly high, in silence, and ranged in order, it is said to indicate fine weather; but if their flight is in disorder, and they speedily return with cries, it foretells wind. If fowls roll themselves in the sand more than usual, it denotes rain; also when the cocks crow in the evening, or at unusual hours. When peacocks roost on the tops of houses, when the raven sails round and round high in the air, and when the song birds carol late in the evening, the weather will continue fair.

The croaking of crows is said to indicate fine weather. When ducks and geese fly backwards and forwards, and frequently plunge into the water, or send forth cries, or when pigeons return slowly to their houses, the probability is that the succeeding day will be rainy. It is a sign of rain or wind when sparrows chirp a great deal; if the redbreast be seen near houses; or swallows fly near the ground, or brush the surface of the water. When sea-fowl and other aquatic birds retire to the sea-shore, or more inland, it generally indicates a change of weather. If larks or kites soar high, and continue so for some time, it is generally a sign of fine weather. If the kingfisher disappear, expect fine weather. If the cuckoo be no longer heard, expect autumnal weather. If swallows and martins fly lower than usual, foul weather may be expected. The cause of this is, that they pursue flies, which delight in warm air; and these insects, escaping from the excess of moisture above, descend nearer to the surface of the earth, and are there pursued by these birds. When the corn crane (*Rallus crex*) ventriloquises in the corn or grass, when the partridge calls in the evening to his mate, and when the snipe booms in the air in the evening, a continuation of fine weather may be expected.

When those rare birds the dotterel and golden plover are seen in the sheep-walks late in the autumn, an early and rigorous winter is certain. The migration of birds is also fraught with interest to the careful observer of the weather. The late roosting of crows (rooks) is a fair criterion of approaching rain. The cause is apparent: they feed upon larvae and earthworms; and these, especially the latter, come most abroad in the evenings before rain.

Mr. Yarrell, in his *History of British Birds*, vol. iii. p. 117, records an instance of instinct, showing how useful an attention to the movements of animals, &c., might occasionally prove:—"I am indebted to the kindness of Lord Braybrooke for the following account of a female swan, on the small stream at Bishop's Stortford. This swan was eighteen or nineteen years old, had

brought up many broods, and was highly valued by the neighbours. She exhibited, some eight or nine years past, one of the most remarkable instances of the power of instinct that was ever recorded. She was sitting on four or five eggs, and was observed to be very busy in collecting grass, weeds, &c., to raise her nest; a farming man was ordered to take down half a load of haulm straw, with which she most industriously raised her nest and the eggs two feet and a half: that very night there came down a tremendous fall of rain, which flooded all the malt shops, and did great damage. Man made no preparation; the bird did. Instinct prevailed over reason; her eggs were above, and only just above, the water."

The same author, in his account of the green woodpecker (*Picus viridis*), known in some localities as the "rain-bird," from being very vociferous when rain is impending, alludes to the probable means by which birds and some other animals become cognisant of approaching changes in the weather. The following is the rationale referred to:—

"It is highly probable that no change takes place in the weather without some previous alteration in the electrical condition of the atmosphere, and we can easily understand that birds, entirely covered as they are with feathers, which are known to be readily affected by electricity, should be susceptible of certain impressions, which are indicated by peculiar actions: thus, birds and other animals, covered only with the production of their highly sensible skin, become living barometers to good observers."—(*Yarrell's Brit. Birds*, vol. ii. p. 136).

Insects, being very sensible of every change in the atmosphere, are good weather guides.

When gnats collect themselves before the setting sun, and form a sort of vortex in the shape of a column, it announces fine weather. If they play up and down in the open air near sunset, they pre-
sage heat; if in the shade, mild and warm showers; but if they sting those passing them, cold weather and much rain may be expected.

If garden spiders break off and destroy their webs, and creep away, expect continued rain and showery weather.

If spider webs (*gossamer*) fly in the autumn, with a south wind, expect an east wind and fine weather.

The following curious observations on the singular foreknowledge possessed by the spider are extracted from a little work entitled *The Pocket Barometer*. This despised insect oftentimes indicates a coming change in the weather ten, twelve, or fourteen days previous to its taking place. The following directions will be a guide to the curious in their observations of this insect:—"If the weather is likely to become rainy, or windy, spiders fix the terminating filaments on which the whole web is suspended unusually short. If the terminating filaments, on the contrary, are very long, the weather will be serene, and continue so for fourteen days. If spiders be totally indolent, rain generally ensues; though their activity during rain is a certain proof of its short duration, and that it will be followed by fine and settled weather. Spiders usually make some alteration in their webs every twenty-four hours. If this take place between the hours of 6 and 7 P.M., it foretells a clear and serene night.

The weather is about to become cloudy and change for wet, when flies sting and are more troublesome than usual. Most insects become torpid when their temperature is much reduced. When it

approaches the freezing point, they fall into a lethargic state, and require no food. Ants present a remarkable exception to this rule; for they are not benumbed till the thermometer is 27° of Fahr., or 5° below freezing point. When bees do not range abroad as usual, but keep in or about their hives, it is a sign of rain.

In the summer season much information relative to the change of the weather may be gained from watching the movements of ants. The finer the day the more busily are they employed, as they never bring out their corn to dry but when the weather is clear and the sun very hot. A celebrated naturalist relates the following curious anecdote:—He one day observed these little creatures, after having brought out their corn at eleven in the forenoon, removing the same, contrary to their usual custom, before one in the afternoon. The sun being very hot, and the sky remarkably clear, he could perceive no reason for it; but half an hour after, his surprise ceased—the sky began to be overcast, and there fell a shower of rain, which caused all this bustle, no doubt, among these active little creatures: they evidently foresaw rain, and provided accordingly; and were we minutely to examine into the economy and management of these wonderful artificers, many other similar and equally curious facts might be gleaned relative to the weather.

The leech also possesses the peculiar property of indicating approaching changes of the weather in a most eminent degree. In fair and frosty weather it remains motionless and rolled up in a spiral form at the bottom of the vessel; previous, however, to rain or snow, it will creep to the top, where, should the rain be heavy, or of long continuance, it will remain for a considerable time,—if transient, it will descend. Should the rain or snow be accompanied with wind, it will dart about with great velocity, and seldom cease its evolutions until it blows hard. If a storm of thunder or lightning be approaching, it will be exceedingly agitated, and express its feelings in violent convulsive starts at the top of the glass. It is remarkable, that, however fine and serene the weather may be, and to our senses no indication of a coming change, either from the sky, the barometer, or any other cause, yet, if the leech shifts its position, or moves about sluggishly, the coincident results will undoubtedly occur within twenty-six hours.

DOMESTIC DYEING.

(Resumed from page 87, and concluded.)

BLACK DYE.

THE substances employed to give a black color to cloth, are, red oxide of iron and tan. These two substances have a strong affinity for each other, and when combined, assume a deep black color, not liable to be destroyed by the action of air or light. Logwood is usually employed as an auxiliary, because it communicates lustre, and adds considerably to the fulness of the black. It is the wood of a tree which is a native of several of the West-India islands, and of that part of Mexico which surrounds the Bay of Honduras. It yields its coloring matter to water. The decoction is at first a fine red, bordering on violet; but if left to itself, it gradually assumes a black color. Acids give it a deep red color; alkalis a deep violet, inclining to brown; sulphate of iron renders it as black as ink, and occasions a precipitate of the same color.

Cloth, before it receives a black color, is usually dyed blue: this renders the color much fuller and finer than it would otherwise be. If the cloth is coarse, the blue dye may be too expensive; in that case a brown color is given by means of walnut-peels.

To dye woollen cloths of a black color.—Wool is dyed black by the following process:—It is boiled for two hours in a decoction of nut-galls, and afterwards kept, for two hours or more, in a bath composed of logwood and sulphate of iron; kept during the whole time at a scalding heat, but not boiling. During the operation, it must be frequently exposed to the air: because the green oxide of iron, of which the sulphate is composed, must be converted into red oxide by absorbing oxygen, before the cloth can acquire a proper color. The common proportions are five parts of galls, five of sulphate of iron, and thirty of logwood, for every hundred of cloth. A little acetite of copper is commonly added to the sulphate of iron, because it is thought to improve the color.

To dye silks of a black color.—Silk is dyed nearly in the same manner. It is capable of combining with a great deal of tan; the quantity given is varied at the pleasure of the artist, by allowing the silk to remain a longer, or shorter time, in the decoction.

To dye cottons and linens of a black color.—It is by no means easy to give a full black to linen and cotton. The cloth, previously dyed blue, is steeped for 24 hours in a decoction of nut-galls. A bath is prepared containing acetite of iron, formed by saturating acetic acid with brown oxide of iron: into this bath the cloth is put, in small quantities at a time, wrought with the hand for a quarter of an hour; then wrung out, and aired again; wrought in a fresh quantity of the bath, and afterwards aired. These alternate processes are repeated till the color wanted is given: a decoction of alder-bark is usually mixed with the liquor containing the nut-galls.

To dye wool, &c., of a brown color.—Brown, or fawn color, though in fact a compound, is usually ranked among the simple colors, because it is applied to cloth by a single process. Various substances are used for brown dyes.

Walnut-peels, or the green covering of the walnut, when first separated are white internally, but soon assume a brown or even a black color, on exposure to the air. They are usually kept in large casks, covered with water, for above a year before they are used. To dye wool brown with them, nothing more is necessary, than to steep the cloth in a decoction of them till it has acquired the wished-for color. The depth of the shade is proportional to the strength of the decoction.

The root of the walnut-tree contains the same coloring matter, but in smaller quantity. The bark of the birch also, and many other trees, may be used for the same purpose. It is very probable that the brown coloring matter is, in these vegetable substances, combined with tan. This is certainly the case in sumach, which is often employed to produce a brown. This combination explains the reason why no mordant is necessary; the tan has a strong affinity for cloth, and the coloring matter for the tan. The dye-stuff, and the mordant, are already, in fact, combined together.

Compound colors.—Compound colors are produced by mixing together two simple ones; or, which is the same thing, by dyeing cloth, first, of the simple color, and then by another. These colors vary to infinity, according to the proportions of the ingredients employed.

To dye different shades of green.—Green is distinguished by dyers into a variety of shades, according to the depth, or the prevalence of either of the component parts. Thus we have sea-green, grass-green, pea-green, &c.

Wool, silk, and linen, are usually dyed green, by giving them first a blue color, and afterwards dyeing them yellow; when the yellow is first given, several inconveniences follow: the yellow partly separates again in the blue vat, and communicates a green color to it; thus rendering it useless for every other purpose, except dyeing green. Any of the usual processes for dyeing blue and yellow may be followed, taking care to proportion the depth of the shades to that of the green required. When sulphate of indigo is employed, it is usual to mix all the ingredients together, and to dye the cloth at once; this produces what is known by the name of Saxon, or English green.

To dye violet, purple, and lilac.—Wool is generally first dyed blue, and afterwards scarlet, in the usual manner. By means of cochineal mixed with sulphate of indigo, the process may be performed at once. Silk is first dyed crimson, by means of cochineal, and then dipped into the indigo vat. Cotton and linen are first dyed blue, then galled, and soaked in a decoction of logwood; but a more permanent color is given by means of oxide of iron.

To dye olive, orange, and cinnamon colors.—When blue is combined with red and yellow on cloth, the resulting color is olive. Wool may be dyed orange, by first dyeing it scarlet, and then yellow. When it is dyed first with madder, the result is a cinnamon-color. Silk is dyed orange by means of carthamus; a cinnamon color by logwood, Brazil-wood, and fustic mixed together. Cotton and linen receive a cinnamon color by means of weld and madder; and an olive color by being passed through a blue, yellow, and then a madder-bath.

To dye of grey, drab, and dark-brown colors.—If cloth is previously combined with brown oxide of iron, and afterwards dyed yellow with quercitron bark, the result will be a drab of different shades, according to the proportion of mordant employed. When the proportion is small, the color inclines to olive, or yellow; on the contrary, the drab may be deepened, or *saddened*, as the dyers term it, by mixing a little sumach with the bark.

THE SWARMING OF THE HONEY BEE.

THE approach of this interesting season is indicated to the bee-master by the appearance of the drones or males, which show themselves about the end of May or the beginning of June, sooner or later, according to the general nature of the climate, and the particular state of the colony to which they belong. In the meantime, the population has increased rapidly, and the heat of the hive is greatly augmented. Excited by these causes, the queen hurries over the combs from one quarter of the hive to another, communicates her agitation to her subjects, and, accompanied by a multitude of them, rushes out of the hive. The bee-owner is forewarned of this revolution by several not insignificant signs. In many cases, for several preceding days, the bees have been hanging in clusters from the mouth of the hive, as if unable to find room within, and desirous of seeking a new domicile; on the morning of the day on which the emigration takes place, they may be observed listless and idle at the entrance, fre-

quently entering within the door, and returning in small parties of two, three, or four, seemingly insensible to the fragrance exhaled from the rich flower-vegetation, and testifying none of their usual activity in profiting by it; while, as the day advances, the males, on the other hand, are hurrying to and fro with a prodigious bustle and noise, as if conscious of some revolution impending in which they would have to bear a prominent part; and, lastly, the moisture or *sweating*, as it is called, which, in the early part of the day, had covered the alighting-board like a heavy dew, is rapidly dried up by the great increase of heat.

A swarm on the wing is a most agreeable spectacle to the bee-master. It is true his harvest of honey might be more plentiful, were the population to remain undivided, and be accommodated with additional room, either by means of storifying or collateral hiving; still, to the lover of nature, the development of the instincts and habits of this interesting insect, which takes place in the process of swarming, is a source of genuine pleasure. At the same time, it must be owned, this pleasure is not always unmingled with anxiety, for his winged favorites sometimes mount high in the air and fly off, perhaps to a habitation previously chosen, and to which they are guided by their scouts. To prevent this evil, the owner and his assistant must hasten to throw up amongst them handfuls of small gravel or earth, which has generally the effect of bringing them down. If it fail, and they seem determined to travel, the owner must prepare himself to follow; for the insects, when thus disposed to wander, condense their straggling circles, and dart off with great rapidity, always in a straight line, and generally against the wind. To put a stop to their flight, the common practice is to make all sorts of noises, ringing of bells, beating of pans and other sonorous vessels. Long experience has satisfied us that the use of these noisy implements is by no means indispensable on such occasions. Ten swarms out of twelve, if let alone altogether, and suffered peaceably to take their own way, will alight on the first shrub, bush, or low-growing tree, that stands in nearly a direct line from the mouth of the hive, whatever may be their intentions as to any ulterior destination; and to defeat such intentions, if any such are threatened, let the swarm, as soon as it has settled on an accessible spot, be housed immediately, and shaded carefully from the sun. In half an hour afterwards, let it be removed to its permanent station in the apiary. If the swarm settle on the branch of a high tree, let a ladder be got and fastened to the trunk by ropes, and let the operator ascend it, carrying up with him a small bag, distended within by a slender hoop in which he will inclose the swarm. The operation will be facilitated, if the branch can be cut and brought down along with it. Sometimes the swarm, after alighting, returns in a few minutes to the hive. This happens when the queen has left, as she sometimes does, the settled group, and makes her way back to her original abode; the swarm will, in these circumstances, gradually follow her and return also, but will come off again next day, or perhaps the same day. Sometimes the bees return to the hive without alighting at all; and sometimes, unfortunately, the queen in such a case commits a mistake and enters a wrong one, while her followers crowd after her, and alight in myriads about the mouth and round the pedestal, without, however, entering with their sovereign, as if aware of the danger of such

intrusion. This is rather a perplexing state of things, and the best remedy we can suggest, is instantly to carry off the hive into which the queen has strayed, and to substitute in its place the one from which she had issued. The bees will readily enter; after which the two hives may be restored to their former places. If the strayed queen does not re-appear in a very few minutes, we may conclude she has fallen a victim to her error; and the owner may console himself with the knowledge that the swarm will come off again in a very few days with another queen.

Two swarms sometimes leave their hives at the same time, and in such cases almost always go together. If they are second swarms, it will be better to let them remain so; they will, when thus united, form a strong stock, and will collect much more honey than they could have done separately. If they are first swarms, and the season is not far advanced, it will be expedient to separate them; and for this purpose, let the whole mass be first received into an empty hive, and then, spreading a sheet on the floor of an empty apartment from which the light is partially excluded, let the hive be placed on it; a smart stroke on the top will send them down in a mass upon the sheet, and the bees, in a minute or two, will be observed collected into two groups, in the centre of each of which will be found a queen. Place an empty hive gently over each group, raising one side, that the bees may have an easy access; and when housed, remove them to their proper stations, which should be some considerable distance apart. The reason for recommending a partially-darkened room is,* that should the operation be performed in the open air, as is sometimes done, and in sunshine, the swarms will almost certainly rise again and may probably be lost.

(To be continued)

PRINTING EARTHENWARE AND CHINA.

Ornamenting biscuit ware is accomplished by *painting* and *printing*, with the distinction of *blue*, because that color was first employed; though now, in both branches, most other colors are used.

Blue painting, or *biscuit painting*, is now practised on only very common earthenware; and in rude patterns, traced by camel-hair pencils, on the surface of tea-ware and jugs.

Blue printing is the name for the manipulations of taking impressions (in colors, blue, green, pink, and brown,) from copper-plates engraved in a style peculiar to artists of the pottery districts; and of sizes varied to the different vessels. The press is made very strong and large, similar to that used for beautiful copper-plate printing for embellishments; usually with cast-iron cheeks and rollers, and an iron lever, not a cross. The press is placed within four feet of a stove-plate, kept constantly heated, that when the copper-plate is laid thereon, its engravings may more easily admit the color as it is rubbed over it. The printer has his thumb and finger protected by a thick slip of leather, and cleans his plate from the scalding color with a stuffed leather boss, not his hand, as other copper-plate printers do.

The *blue* color is blue calx, 37; flint, 42; nitre, 6; borax, 15; well ground together; (and in similar proportions for other colors;) the tint being heightened or lowered by the quantity of the calx.

Brown.—Litharge, 37; crude antimony, 37; manganese, 18; and blue calx, 8; calcine and grind well together for use.

Black.—Red lead, 60; antimony, 25; manganese, 15; calcine, then grind with blue calx, 40; oxide of tin, 5; and calcine for use.

Mulberry.—Manganese, 54; blue calx, 26; nitre, 14; borax, 6; calcine over pulverised nitre; then grind well with glass, 18; flint, 10; for use.

The color is well mixed on a very hot iron plate, into a fluid, called technically an *oil*, prepared thus:—Over a slow fire, in a vessel kept loosely covered, for two hours boil one quart of pure linseed oil, then add one pint of pure rape oil, and two ounces of capivi balsam, and boil two hours longer. When a little cooled, (to 160°) add, of amber oil, white lead, and clean pitch, severally half an ounce; resume the boiling, and continue it forty-five to seventy-five minutes, according to the strength of tint for which it is wanted. Some printers prefer to the latter ingredients, one ounce of oil of tar, and one ounce of balsam of sulphur, very carefully introduced, else the whole will be spoiled by coagulation.

The printer places his plate on the stove, rubs in the color, with a broad pallet knife scrapes off the excess, and then with his boss cleans the plain sides, and places it on the bed of his press; he next brushes the sheet of tissue paper over with a solution of soft soap and water, puts it on the plate, rolls it between the rollers, and the instant the return of the press leaves it dry by the hot plate, he carefully takes it off and examines that the impression is a good one, and that the color properly adheres. Thus he proceeds till his quantity is taken off. Messrs. Machin and Potts, Burslem, use *engraved rollers* for the purpose, instead of plates. Their machinery is, at present, not exhibited to strangers; but the suggestion seems taken from calico printing, with which branch Mr. Potts was some years connected.

A *cutter* (a little girl, training up for the next manipulation,) takes the impression, cuts away all the white paper, then separates the impression into its parts, which she places in the order most readily facilitating their application to the ware.

A *transferer*, with considerable tact and judgment, places on a biscuit vessel the several parts in their proper arrangement; and then with a rubber of flannel, six to sixteen inches long, and firmly rolled and tied together, with the ends a little loose, she rubs the paper upon the article, with much force, often resting one end in the right arm-pit, until it cannot again be taken off. The dry and absorbent porosity of the ware aids the adhesion of the color in the oil, and when the task is completed, each vessel is taken off the board on which it was placed by the transferer, immersed in water, and with soft soap and a brush the paper is washed off, and leaves in the ware only the mineral color, and a little of the oily medium. The ware is kept in a heated room to evaporate much of the water imbibed in washing off the paper, which is requisite to prepare it for the fluid glaze; and also, is heated to a red heat, to *harden on the color*, and volatilise the oily particles, else the glaze would not adhere.

Ornamenting of glazed ware.—This includes *black printing*, *lustering*, and *enamelling*.

Black printing is the term for applying impressions to glazed vessels, whether the colors be black, red, or gold. The copper-plates are engraved in a style differing from those employed in *blue printing*; and the colors are different in components and preparation.—The following are the components of the colors:—

Black.—1. Copper calx, 20; flux, 80.

2. Copper calx, 25; flux, 75.

3. Calcined borax, 46; calcined umber, 35; blue calx, 9.

4. Calcined borax, 25; calcined umber, 75, for gilded ware. The *green*, *purple*, and *pink*, are the enamel colors, fluxed a little more. Instead of using *paper* for taking off impressions, the black printer employs glue bats, prepared in this manner:—A definite quantity of good glue is soaked well some hours in water; it is next put into a large jug, and by the heat of boiling water evaporated during four hours; afterwards it is poured out on large well-glazed flat dishes, to the thickness of one-eighth of an inch, and left to cool. The glue is next cut into pieces, technically called *papers*, corresponding in size to the plates. The printer rubs his color, in the state of an impalpable powder, well in a saucer, with a lock of carded cotton, well dried. He, with rosin, fixes his plate to a wood prism, as a handle, then rubs into the engraving his oil, (a mixture of cold-drawn linseed oil, and oil of turpentine, or Barbadoes tar,) and, with much pressure, the glue paper abstracts the oil out of the engraving, and being immediately laid carefully on the ware, previously wiped very clean, the oil, by a gentle pressure, adheres; he next with a sponge cleans the paper, and leaves it to dry while he applies the powdered color, by the cotton to the oiled design. With a series of papers he proceeds successively till his complement of ware is finished; and, afterwards, commencing with the vessels first printed, with silk rags he cleans off all superfluous color from the design, and wipes all the other parts clean from whatever might be likely to adhere to the glaze while being baked in the muffle.

Lustred ware.—The body is usually formed of common brick clay, 60; and blue clay and black marl, 20 each, blanged well, and properly lawned; fired biscuit, and then covered with the brown glaze, No. 3. The components for the lustres are thus combined:—

Gold.—In nitro-muriatic acid, sufficient, dissolve,

Gold, 120; grain tin, 5: mix with (by heat).

Balsam of sulphur, 60; spirits of turpentine, 40.

Drop the acid solution in while stirring the medium; and when well mixed, use with best turpentine only. 1 ounce of gold makes 32 of lustre.

Persian gold lustre.—In fat oil on a tile, placed on a hot stove, mix dry oxide of gold, and when eliquation commences, stir with palette knife, and add more oil till 25 be used, and the color resemble that of balsam of sulphur; then diminish the temperature, and gradually add turpentine, 75.

Silver or steel lustre.—In muriatic acid, concentrated, dissolve platinum till the acid be saturated. Then at 112° Fahrenheit, to 25 of solution, add very carefully, and in small doses, 75 of spirits of tar. The chlorine will be evolved by the heat, and the chloride of platinum will remain in the tar. The metallic composition is applied to the ware by broad hair pencils; and this last, baked in a muffle, at enamelling heat, is *steel lustre*. Then in water mix the oxide of platinum, (obtained by sal ammoniac precipitating it from the acid solution,) and cover the steel lustre; again bake, and it will be *silver lustre*. If the glaze be opaque, not brown, this latter will at once give *silver lustre*. The gold lustre is used with turpentine similarly; and, recently, a new kind has been in the market, of whose components we have not yet been able to obtain determinate knowledge.

OSSIFEROUS CAVERNS, AND OSSEOUS BRECCIA.

It is to Prof. Buckland that we are indebted for our more intimate acquaintance with the various circumstances under which organic remains are found in caverns; for though bones of bears and other animals, occurring in caves, had long attracted attention, more particularly in Germany, it was not until after the discovery of the celebrated Kirkdale cavern in Yorkshire, that the subject acquired a new interest, and became as much a part of general geological investigation, as the fossil contents of any well established rock had previously been.

Since the discovery and description of Kirkdale cavern, notices of other ossiferous caves have become so numerous that a mere list of them would be somewhat long; and they multiply so fast, that we may anticipate, at no distant period, a very singular body of evidence on this subject alone.

The remains of animals, similar to those contained in caverns, are frequently found in fissures of the rock; in some situations, the whole mass of bones, fragments of rock, and cementing matter being so hard and compact, that it frequently equals, and sometimes exceeds, in durability, the rock within which it is inclosed. Of this the *osseous breccias* of Nice and many other places in the Mediterranean are examples.

Kirkdale cavern was discovered by cutting back a quarry, in the summer of 1821, and was visited by Prof. Buckland in December of the same year. Its greatest length is stated at 245 feet, and its height generally to be so inconsiderable, that there are only two or three situations where a man can stand upright. The surface of the sediment when the cave was opened was nearly smooth and level, except in those parts where its regularity had been broken by the accumulation of stalagmite above it, or ruffled by the dripping of water: its substance is an argillaceous and slightly micaceous loam, composed of such minute particles as would easily be suspended in muddy water, and mixed with much calcareous matter, that seems to have been derived in part from the dripping of the roof, and in part from comminuted bones. At about 100 feet within the cave's mouth the sediment became more coarse and sandy.

According to Dr. Buckland, the following are the animals, the remains of which were found in the Kirkdale cavern: *Carnivora*;—Hyæna, Tiger, Bears, Wolf, Fox, Weasel. *Pachydermata*;—Elephant, Rhinoceros, Hippopotamus, Horse. *Ruminantia*;—Ox, and three species of Deer. *Rodentia*;—Hare, Rabbit, Water-rat, and Mouse. *Birds*;—Raven, Pigeon, Lark, a small species of Duck, and a bird about the size of a Thrush.

From the mode in which these remains were strewed over the bottom of the cavern when the mud was removed, the great proportion of hyæna teeth over those of other animals, and the manner in which many of the bones were gnawed and fractured, Prof. Buckland inferred that this cavern was the den of hyænas during a succession of years; that they brought in, as prey, the animals whose remains are now mixed with their own; and that this state of things was suddenly terminated by an irruption of muddy water into the cave, which buried the whole in an envelope of mud. The inference of the hyænas having been long resident in the cave, was strengthened by the occurrence of their faeces, precisely as would happen in a den of hyænas at the present day. In addition to which, it

was further observed, that many bones were rubbed smooth and polished on one side, while the opposite side was not. This, Prof. Buckland considered was produced by the friction of the animals walking or rubbing themselves upon the bones.

The German caverns of Gailenreuth, Killoch, Bauman, &c. contain an abundance of bones, nearly identical, according to Cuvier, over 200 leagues; by far the greatest proportion being referrible to two extinct species of Bear, *Ursus spelæus* and *U. arctoides*. The remainder consisted of the extinct *Hyaena* (the same as at Kirkdale), a *Felis*, a Glutton, a Wolf, a Fox, and Polecat. These caverns so far resemble Kirkdale cave, that there is more or less of a stalagmitic crust, beneath which the bones are discovered, the stalagmitic matter being frequently transfused through the previously deposited sediment. There is, however, one fact connected with these caverns, wherein they differ very considerably from the Yorkshire cave. In the latter, no rolled pebbles were observed; while in the former they have been noticed in some places. Thus, in Bauman's Höhle, pebbles of various sizes are stated to occur among crushed and pounded bones; leading to the presumption that the pebbles broke the bones, for the sand and mud of the same chamber contain them nearly entire. It would therefore appear that water had rushed into the cave, bringing with it rolled pebbles of the surrounding country, crushing and distributing the previously accumulated bones. Be the origin of the pebbles, sand and mud, what it may, it seems clear that the remains of various animals were enveloped by them; since which there has been a long continuance of repose, permitting, in most cases, the deposit of stalagmite upon the ossiferous mass. Prof. Buckland states that Mr. M'Enery found rounded pebbles of granite, of the size of an apple, mixed with the bones under the stalagmite in Kent's Hole, Torquay; and he states that he has found pebbles of greenstone, completely rounded, in the same place; and that in some parts of Kent's Hole, particularly the lowest, the bone breccia is full of fragments of grauwacke and slate, some of them rolled, some angular. The cave itself is situated in a limestone resting on shale, and the grauwacke and slate are rocks of the country; but the granite is at a distance, not nearer than Dartmoor.

A very common condition of cavern bones is their being found mixed with angular fragments of the rock in which the caverns occur. Banwell Cave, in the Mendip Hills, is a good example of a large accumulation of the remains of *Ursus*, *Cervus*, *Bos*, and other animals, with fragments of carboniferous or mountain limestone, the rock in which the cavern is formed. The contents of this cave merely require a calcareous cementing matter, to become an osseous breccia, such as is found at Nice and other places on the shores of the Mediterranean. The osseous breccia of the Chateau Hill at Nice, appears indeed to have been partly a cavern, which has been quarried away by the works constantly carried on there. Other osseous breccias are common in the vicinity, some being at least 500 feet above the level of the present Mediterranean: the cement reddish, and often vesicular; the vesicles being lined with carbonate of lime. A portion at least of this osseous breccia would seem to have been formed beneath the sea, for it contains marine remains.

Similar osseous breccias occur at Gibraltar, Certe, Antibes, Corsica, and various other places on the

shores of the Mediterranean. The bones found at these places consist, according to Cuvier, (besides those referrible to Horse, Oxen, and large Deer,) of Deer of the size of the Fallow Deer (Gibraltar, Certe, Antibes); Deer resembling, in their teeth, some in the Indian Archipelago (Nice); a smaller species (Nice); a species of Antelope or Sheep (Nice); two species of Rabbit (Gibraltar, Certe, Pisa, &c.), one resembling the common Rabbit, the other smaller; *Lagomys* (Corsica, Sardinia); species of *Mus*; *Felis* (Nice); *Canis* (Sardinia); Lizard (Sardinia); Land Tortoise (Nice).

Osseous breccias are not confined to Europe, for it now appears that they are discovered in Australia. According to Major Mitchel, the principal ossiferous cavity is situated near a large cave in Wellington Valley, about 176 miles from Newcastle, through which valley flows the river Bell, one of the principal sources of the Macquarrie. This cavity is described as a wide and irregular kind of well or fissure, accessible only by ladders or ropes, and the breccia is a mixture of limestone fragments of various sizes, and bones enveloped in an earthy red calcareous stone. Such of the bones, forwarded to Europe, as were inspected by Mr. Clift, were referred by that anatomist to the *Kangaroo*, *Wombat*, *Dasyurus*, *Kooc'a*, and *Phalangista*, all animals at present existing in Australia. With these were found two others; one of which, considered to be that of an elephant, was obtained in a singular manner by Mr. Kankin, who first visited this fissure; for, supposing it to be a projecting portion of the rock, he fastened the rope by which he descended to it, and was only undeceived by the support breaking, and showing itself to be a large bone.

Mr. Pentland considers that the bones from the Australian breccia, forwarded to Paris, and examined by Baron Cuvier and himself, belong to fourteen species of animals, referrible to the following genera: *Dasyurus*, or Devil of the colonists, three species, one of which does not seem to differ from the *D. Macrourus* of Geoffroy; *Perameles*, one species; *Hypsiprymnus*, or Kangaroo Rat, one species; *Macropus*, or Kangaroo proper, three or four species; *Halmaturus*, three species; *Phascolumys*, or Wombat, one species; a small animal of a new genus, and of the order of *Rodentia*; Elephant, one species; and a saurian reptile allied to the genus *Gecko*. Of these, three or four only are known to zoologists as recent animals. Mr. Pentland found many fragments of bones evidently gnawed, and the epiphysis of the long bones was always absent.

Major Mitchel notices other and similar breccias on the Macquarrie, eight miles N. E. from the Wellington cavity; as also at Boree, fifty miles to the S. E., and at Molony, thirty-six miles to the E.; the latter, according to this author, containing bones apparently larger than those of the animals now existing in the country.

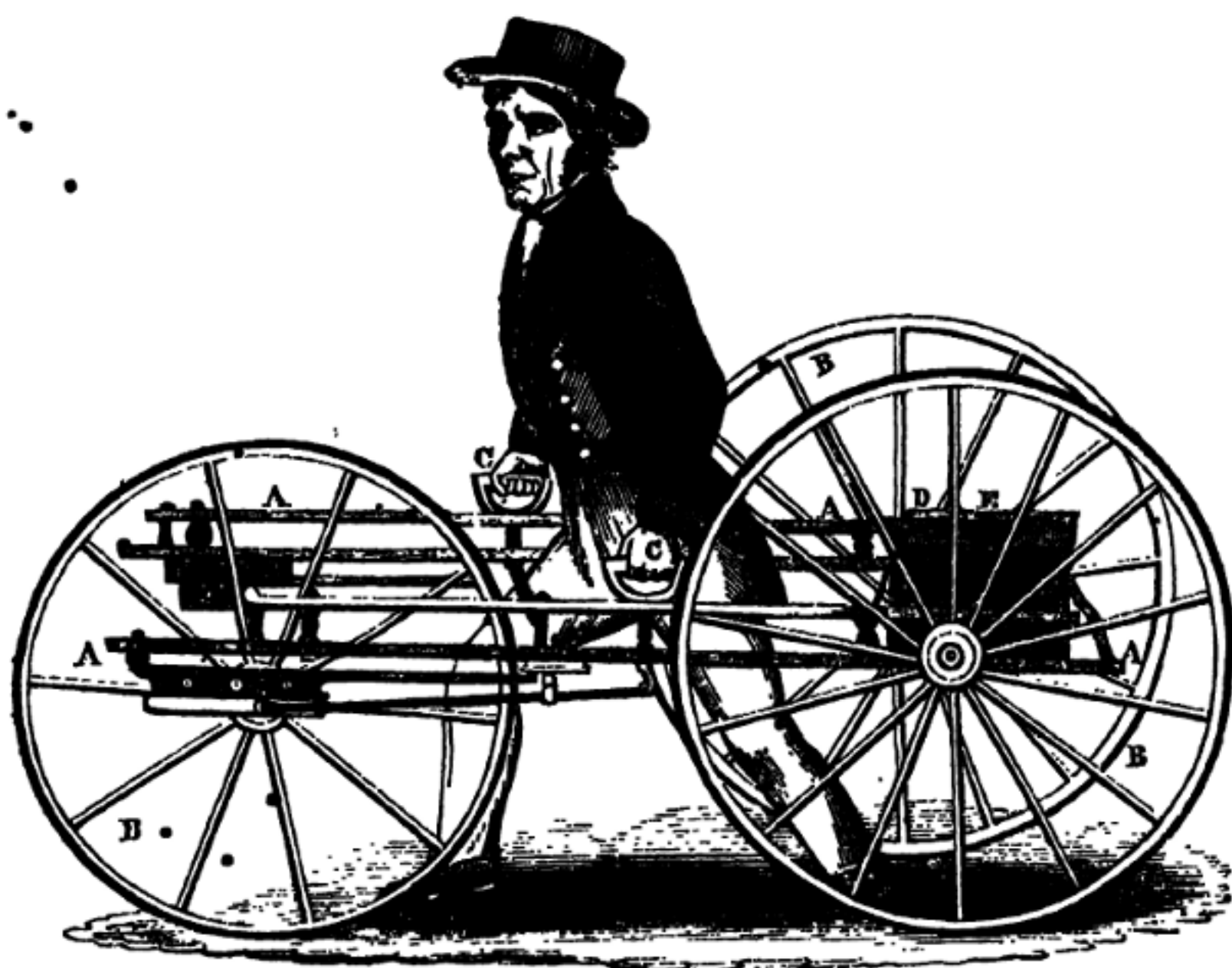
Before we conclude this subject, we should notice an ossiferous cavern on the banks of the Meuse, at Chockies, about two leagues from Liège, which exhibits some curious circumstances. Fragments of limestone, of the same kind as that in which the cavern occurs, are mixed with some quartz pebbles, and with bones, mostly broken; the whole being united by a calcareous cement. The bones and teeth occur equally in the solid breccia and mud, which, with three beds of stalagmite, nearly fill the

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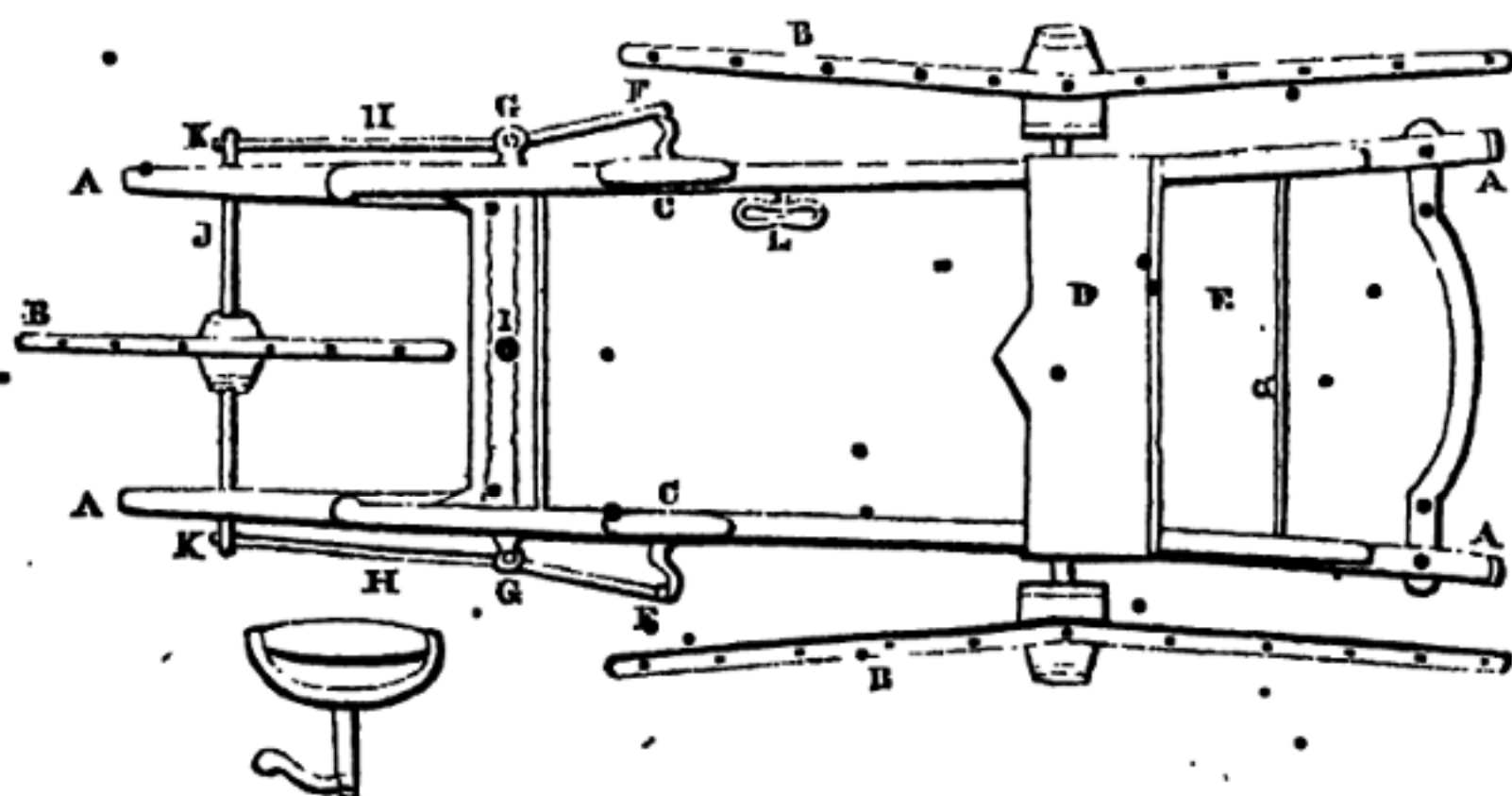
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GOOCH'S AERIPEDIS, OR PEDOMOTIVE CARRIAGE.



GOOCH'S ÆRIPEDIS, OR PEDOMOTIVE CARRIAGE.

(To the Editor.)

SIR.—If you think the following worthy of a place in your valuable Journal I shall feel much obliged for its insertion. I trust that the machine may be found so far practicable as to become useful to some of your readers; for notwithstanding the great number of vehicles of a similar description that have been constructed at various periods, by different individuals, some with great ingenuity and mechanical skill, yet, on the other hand, many have been imitated with an utter disregard of mechanical principles; and all or most of which I have seen, or had drawings of, seem to come under one general term—a *useless toy*. Now should mine, either by the amateur or the mechanical practitioner, be considered to fall under the same title, of course I must *bear the rub*; but, Mr. Editor, I must say I have made this *hobby* one of my peculiar hobbies for more than twenty years. I first tried the common velocipede, or dandy horse, condemned it, and tried again and again, upon different mechanical principles, the treadle, the winch, the crank, and the hand lever. They have all come under my repeated trials, and all by me are equally condemned. I find that a carriage of any kind, moved by machinery, let its combinations be ever so simple, and its propelling power is to be put in action by muscular energy, either by the feet or arms, must be attended eventually with fatigue of body; for not only the weight of the machine to be moved, perhaps from 80 to 100 lbs., but also the weight of the driver himself, which is from 140 to 150 lbs. more, is to be moved by muscular action alone. All this is seldom considered by the amateur in his pleasing dreams of rail-road speed with his new carriage. His machine is at length completed, and brought out,

“To take a quiet ride in some green lane,”

and, to his great mortification, his plan is tried, and is “found wanting.” The first inquiry is, “What is amiss?” Some crank, some lever, some unfortunate wheel is not rightly applied; it must be altered, it must be modified; and so it is, till at last it is laid aside, perhaps hurled headlong into a garret or lumber-room, as waste material, the result of the inventor’s folly. I have seen several, not only of my own, but also of others, come to a similar fate.

As I have said above, I have examined a great variety of plans, but the inventors have so often forgotten that man is to be the power applied, who is certainly a progressive animal, but at the same time is but a walking animal; and I fear he can never become anything else by his own exertion. I do, therefore, consider, that the nearer we can come to the natural movement of man, to aid his progress, the nearer we shall come to the proper method. I have accordingly invented a *Walking Machine*, of which the following is a description:—It consists of a strong but light double frame, A A, A A, mounted on three light wheels, B B B, with a seat and travelling box, D E; C C are two handles (see Fig. 2,) by which the pedestrian is to lead and guide the machine. The uprights of these handles turn in a socket or hole in the frame, and on the lower extremity have arms fixed, (F F) about 3 inches long; to these the connecting rods are jointed as at G G, H H, and K K. The axis of the fore wheel (J) slides or ranges in a groove at

the lower extremity of the frame A A, and by turning these handles either to the right or the left, the machine may be managed with the greatest nicety. G G is the connecting bar under the fore cross piece of the frame, shown by the dotted lines, and moves on a pin as at I, and keeps the fore wheel in its proper position. L is a small foot-step to rest the foot on when riding.

I think I before stated, that there are several machines in Norwich, and I think there are at least five on this same principle, which seems to be the most useful. Four of us, the other day, went a journey from Norwich to Cromer and back again the same day, which from my house at Lakenham is a distance of 47 miles. We were not tired; one of the party is but seventeen years of age, I am upwards of sixty, the other two are middle-aged men. We now contemplate another journey,* of 56 miles, as soon as there comes some rain to cool the roads, and I have no doubt but we shall accomplish it in a day with but little difficulty; as about seven years ago I had one of these machines in which I travelled 61 miles in a day, and was not more tired than I should have been in walking 20 miles. The reason is, this: the pedestrian, whilst walking, places himself inside the frame, leans forward on the two handles, and is assisted on his way by the motion of the machine, which carries him nine or ten feet at every stride. We can walk up a hill, or an inclined road, at about four miles per hour, without much exertion; move on a level road at five miles per hour; and go down hill at ten or twelve miles per hour; and riding at the same time; so as to average about six or seven miles per hour, with much ease. G. K. GOOCH.

Lakenham:

THE SWARMING OF THE HONEY BEE.

(Resumed from page 119, and concluded.)

Second Swarms.—In ten or twelve days after the departure of the old queen with her followers, the hive is in a state to send forth another band of emigrants. The young queen, thwarted by the workers in her attempt to destroy her rivals yet in their cradles, traverses the combs in every direction in a state of great agitation, causing by her impetuous courses disorder and confusion amongst the inhabitants, and thereby raising the temperature of the hive to such a height, that the bees, unable to support the augmented heat, hurry along with their irritated queen towards the outlet of the hive, and depart. As there are often from six to ten queens, and sometimes even more, in the hive, two or three will often be found in a second swarm, which has frequently the effect of dividing it, each portion alighting on a separate bush. The operation of uniting them is simple and easy. Cut the branch which carries the smallest portion, and place it in contact with the other; they will soon unite. Or receive first the one group into an empty hive, and placing it immediately under the other, shake this last down upon them, and the junction is effected. The bees will quickly rid themselves of the super-numerary queen.

Third Swarms.—It is in consequence of this multiplicity of queens, that sometimes a third, and even a fourth, emigration takes place from the

* We have received a second letter from our ingenious Correspondent, in which he informs us that this journey has been accomplished with perfect success, and without much fatigue.—Editor.

mother-hive,—the former on the third day after the second, and the latter on the day following. To establish these as separate and independent colonies would be ultimately a loss to the owner,—the swarm or cast itself would do little good, and the parent hive would be impoverished to such a degree as to render it unfit for a winter stock. The third and fourth swarms, therefore, ought to be restored to their original habitation, taking care previously to search for and seize the queen or queens, which in these small swarms is not a difficult operation. If the operator is successful in his search, the bees will return of themselves. Even a second swarm is seldom worth much, unless the prime one has been particularly weak, and would be much more productive to the owner by its continuance in the parent hive. Our fondness for having our apiaries stocked with a great number of hives is apt to make us overlook the disadvantage of having—as we are sure to have by indulging ourselves in this desire—puny stock-hives which give much trouble, and cost a great deal more than they are worth; for in this country, second swarms that come off later than June, seldom do any good, unless they are situated in the immediate neighbourhood of heath, or are transported thither in August or September. He is a wise bee-master, then, who takes but one swarm from each stock; he may, generally speaking, depend on having stronger swarms, and a greater quantity of honey than he would have procured from double the number of seconds. There is but one way of preventing second swarms, and that is, by giving them more room, and destroying all the remaining royal cells, as soon as it is ascertained that a young queen has been hatched, to preside over the community. A first swarm departs only on a fine day, when the sky is clear, and the sun shines; a second, or a cast, is not so scrupulous. Should the weather become wet immediately after the emigrants have been housed, they must be fed.

Virgin Swarms.—When the swarming season has been early and favorable, a strong first swarm sends forth sometimes a young colony headed by the old queen. For the first few days after she had taken possession of her new abode, she has laid the eggs of workers in great numbers. Portions of comb containing large cells are at the same time constructed, in which she lays the eggs of males. The workers are thereby encouraged to build royal cells; and, if the weather be favorable, at the end of a month from the time of her leaving her original abode, the old queen leads off a new band of emigrants. The product of this swarm, if suffered to exist separately, is called *virgin honey*. What has been said of the value of second, third, and fourth swarms, is equally applicable to swarms of this description. Unless in very particular circumstances, they are not only not advantageous, but positively injurious to the general prosperity of the apiary, and should therefore be prevented.

A timid and inexperienced cultivator of bees may shrink at the description of some of the dangerous operations ventured on with such irritable subjects, and will be disposed on every occasion of this kind to esconce himself in impenetrable defensive armor. In forming artificial swarms, in depriving the bees of their hard-earned stores, or interfering in any way with the brood, he will do well to protect himself by such means. But in regard to natural swarms, he need be under no apprehension, and this panoply is then quite unnecessary. Every person accustomed to work amongst bees, knows how

safely he may go into the midst of a newly-departed swarm, not one bee of which will molest him, unless he accidentally crush or injure it during his operations. They are so intent on the great object of their emigration, the acquisition of a new abode, and so sensitively anxious about the safety of their mother and queen, that what on ordinary occasions would draw forth many a vengeful weapon, now passes utterly unheeded by them; and the cultivator may, in the event of their clustering in an inconvenient spot for being hived, lift them in handfuls like so much grain, without in the least suffering for his boldness.

The following instance, from M. Lombard, in proof of this, is very interesting, and worthy of being repeatedly brought forward, not only as illustrating a remarkable feature in the history of the bee, but as being well calculated to inspire confidence in those who are required to work amongst these sensitive creatures at the swarming season:—“A young girl of my acquaintance was greatly afraid of bees, but was completely cured of her fear by the following incident. A swarm having left a hive, I observed the queen alight by herself, at a little distance from the apiary. I immediately called my little friend, that I might show her this important personage; she was anxious to have a nearer view of her majesty, and therefore, having first caused her to draw on her gloves I gave the queen into her hand. Scarcely had I done so, when we were surrounded by the whole bees of the swarm. In this emergency I encouraged the trembling girl to be steady, and to fear nothing, remaining myself close by her, and covering her head and shoulders with a thin handkerchief. I then made her stretch out the hand that held the queen, and the bees instantly alighted on it, and hung from her fingers as from the branch of a tree. The little girl, experiencing no injury, was delighted above measure at the novel sight, and so entirely freed from all fear, that she bade me uncover her face. The spectators were charmed at the interesting spectacle. I at length brought a hive, and shaking the swarm from the child's hand, it was lodged in safety without inflicting a single sting.”

STARRY NEBULÆ.

There are various forms and classes of nebulae, but they may all be reduced to two great classes,—the *resolvable* and *irresolvable*; that is, those which may be resolved into clusters of stars by powerful telescopes, and those which no telescope hitherto constructed has yet been able to resolve into starry groups.

Prior to Sir W. Herschel's observations on the nebulae, about a hundred of these objects had been described in different parts of the heavens, of which an account had been given by Messier. About 2000 more were afterwards discovered by the unwearied exertions of our British astronomer, a description of which was inserted at different periods in the “*Philosophical Transactions*.” The places of these were afterwards computed from his observations, and arranged into a catalogue, in the order of right ascension, by his sister, Miss Caroline Herschel, a lady singularly eminent for her astronomical knowledge, who assisted him in all his sidereal labours and discoveries, and was herself a discoverer of several interesting celestial phenomena, particularly comets. Her illustrious nephew, Sir John Herschel, read a paper before the

Royal Society in November, 1833, in which he gives the places of 2500 nebulae, or clusters of stars, of which 500 were detected by his own observations, the rest having been accurately determined by his father. Besides these, more than 500 nebulae have been discovered in the southern hemisphere of the heavens, of which the Magellanic clouds are the most conspicuous and the most remarkable. They are three in number, two of them being near each other; the largest is at a considerable distance from the south pole, but the other two are only eleven degrees distant. To the naked eye, they appear like portions of the milky way.

These nebulae have great variety of forms: some are comparatively bright, and others so obscure as to render it difficult to detect them in the field of the telescope, or to ascertain their shape. Some of them appear round, some oval, and others of a long elliptic shape; some exhibit an annular form, like luminous rings, and others like an ellipse with a dark space in the centre; but the greater number approximate to a roundish form. Of the 103 nebulae inserted in Messier's list, eighteen were known at the time to consist of small stars; but Sir W. Herschel afterwards found twenty-six more of them to consist purely of clusters of stars, eighteen of small stars accompanied with nebulosity, and the remainder not resolvable into stars by the highest powers of his telescopes. It is evident that these objects, however apparently small and obscure, must be bodies of *immense magnitude*, when we take into consideration the vast distance at which they must be placed from our globe. The following are Sir W. Herschel's views on this point:—

"My opinion of their size is grounded on the following observations:—There are many round nebulae of about five or six minutes in diameter, the stars of which I can see very distinctly; and on comparing them with the visual ray calculated from some of my long gauges, I suppose, by the appearance of the small stars in those gauges, that the centres of these round nebulae may be 600 times the distance of Sirius from us." He then goes on to show that the stars in such nebulae are probably twice as much condensed as those of our system, otherwise the centre of it would not be less than 6000 times the distance of Sirius, and that it is possibly much underrated by supposing it only 600 times the distance of that star. "Some of these round nebulae have others near them, perfectly similar in form, color, and the distribution of stars, but of only half the diameter; and the stars in them seem to be doubly crowded, and only at about half the distance from each other. They are indeed so small as not to be visible without the utmost attention. I suppose these miniature nebulae to be at double the distance from the first. An instance equally remarkable and instructive is a case where, in the neighbourhood of two such nebulae as have been mentioned, I met with a third similar, resolvable, but much smaller and fainter nebula. The stars of it are no longer to be perceived; but a resemblance of color with the former two, and its diminished size and light may well permit us to place it at full twice the distance of the second; and yet the nebulosity is not of the milky kind, nor is it so much as difficultly resolvable or colorless. Now in a few of the extended nebulae, the light changes gradually, so as from the resolvable to approach to the milky kind; which appears to me an indication that the milky light of nebulae is owing to their much greater distance. A nebula, therefore, whose

light is perfectly milky cannot well be supposed to be at less than six or eight thousand times the distance of Sirius; and though the numbers here assumed are not to be taken otherwise than as very coarse estimates, yet an extended nebula which in an oblique situation, where it is possibly foreshortened by one-half, two-thirds, or three-fourths of its length, subtends a degree or more in diameter, cannot be otherwise than of a *wonderful magnitude*, and may well *OUTVIE OUR MILKY WAY IN GRANDEUR*."

It appears to be a very natural conclusion, that the nebulae which are perfectly similar in form, color, and the distribution of stars, but only of half the diameter, and the stars doubly crowded, are about *double the distance from the first*. And if the distance of the larger nebulae, whose stars are distinctly seen, be at least 600 times the distance of Sirius, as there is every reason to believe, then the distance of those which are only half the diameter must be about 1200 times the distance of that star; that is, at the very least, 24,000,000,000,000,000 or twenty-four thousand billions of miles. But the nebulae, whose light is "perfectly milky," or so far removed from us that the stars of which they are composed cannot be separately distinguished, may be justly considered as 7,000 times the distance of Sirius, or, in numbers, 168,000,000,000,000,000, or one hundred and sixty-eight thousand billions of miles!—a distance of which we can have no distinct conception. Light, notwithstanding its amazing velocity, would be nearly 30,000 years ere it could fly from such nebulae to the earth; and a cannon ball, with its utmost velocity, would require more than *thirty-eight thousand millions* of years before it could move over an equal space. Since the distance of these nebulae is so immense, and since those which are among the largest and nearest are found by actual observation to be composed of countless numbers of stars, leaving us no room to doubt that the most distant are also immense systems of stars, how great must be *the magnitude*, and how inexpressible the grandeur, of the numerous luminaries of which they are composed!

We have stated above that more than three thousand nebulae have already been discovered, and whose places in the heavens have been accurately determined, so that those who have access to powerful telescopes may have an opportunity of observing the greater part of them. From all the observations made by Sir W. Herschel, he is of opinion that our nebula, or the milky way, is *not* the most considerable in the universe; and he points out some very remarkable nebulae which in his opinion cannot be less, but are probably *much larger*, than that of which our sun and system form a part. Now, on these grounds let us consider what must be the extent and magnitude of only the *visible universe*. Supposing the number of stars composing the milky way to be ten millions, and that each of the nebulae at an average contains the same number; supposing further, that only two thousand of the three thousand nebulae are resolvable into clusters of stars, and that the other thousand are masses of a shining fluid not yet condensed into distinct luminous globes; the number of stars, or *suns*, comprehended in that portion of the firmament which is within the reach of our telescopes would be 20,000,000,000, or, *twenty thousand millions*, which is twenty millions of times the number of all the stars visible to the naked eye.

Great as this number is, and magnificent and

overpowering as the ideas are which it suggests of the extent of creation, yet these vast assemblages of systems may be no more than as a single nebula to the whole visible firmament, or even as a grain of sand to the whole earth, compared with what lies beyond the range of human vision, and is hid from mortal eye in the boundless and unexplored region of immensity! Beyond the boundaries of all that will ever be visible to the inhabitants of our globe, an infinite region exists, in which we have every reason to believe the Deity sits enthroned in all the grandeur of his overflowing goodness and omnipotence, presiding over innumerable systems, far surpassing in magnificence what "eye hath yet seen" or the most brilliant intellect can conceive. For we ought never for a moment to surmise that the operations of Almighty Power are exhausted at the point where the efforts of genius and art can no longer afford us assistance in tracing the footsteps of the Divinity through the mysterious regions of infinitude; nor should we ever suppose that man, placed on such a diminutive ball as the earth, and furnished with powers of so limited a nature as those with which he is now invested, will ever be able to grasp the dominions of Him who fills immensity with his presence, and "whose ways are past finding out."

THE SILLOMETER.

THE imperfection attending the action of the log in ascertaining the rate at which ships are sailing, has long been felt, and other means of attaining the same object have been anxiously desired by all captains of ships. An apparatus has been contrived and patented by M. Clement, of Rochefort, called a *Sillometer*, or watch, for indicating the speed of a ship, which has successfully accomplished the purpose. M. Clement has also patented this invention in England, and two others connected with it. The *Sillometer* consists of a piece of copper, called by the inventor the *agent*, against which the water acts. This agent is attached to a moveable plug of the same metal, which slides in a copper tube fixed through the centre of the vessel to the keel; to this plug is attached a lever, which, by means of a vertical rod, acts on a second lever placed on the deck of the vessel, and communicating with a spring; the tension of the spring constitutes an equilibrium with the presence of the water on the *agent*, and serves to measure the rate at which the ship is moving by means of a hand, the movement of which on a graduated dial indicates, at every moment, not only the speed of the ship, but also the distance run in any given time, by marking all the distances passed within short intervals. A table annexed to the instrument allows the officer on the watch to note the distance traversed at the moment when his watch is relieved. The *sillometer* resolves many problems of great importance. It gives every moment the rate of the ship's sailing, and also the space traversed in any given time. It indicates positively either the influence of a sail furled or unfurled, of a change in the placing of the ballast or of the guns, and what is the most favorable direction of the wind for its action on the sails, which is very important either in giving chase or endeavouring to get away. It offers also the advantage of measuring, when at anchor, the force of currents on the keel. The second of M. Clement's inventions is called a *Direvometer*, or watch to ascertain a ship's lee-way. It is moved by a paddle, that may be placed under the

keel at will, and is supported by a plug sliding in a tube like that of the *sillometer*, but turning with the paddle and the rod. This motion is produced in two semicircles, one of which indicates the lee-way to larboard, the other to starboard. When at anchor, the instrument will show clearly the directions of the currents. The third invention is a *Submarine Thermometer*. It appears from the thermometrical observations of many scientific navigators, that in seas of unfathomable depth the water is not so cold as over banks; and that over banks near the shore it is less cold than over those at a greater distance, but colder than in the open sea. M. Clement, by making use of his *sillometer* tube, places at the bottom of the plug which sustains the *agent* of the *sillometer* a metallic thermometer, formed of a strip composed of two metals, and turned in a spiral shape, which is fixed by one end to the plug, and by the other to a vertical rod, which is so adapted as to turn two hands; one of which moves at the least alteration in temperature; whilst the other follows the angle of rotation of the rod. In the experiments made on the coast of France, results have been obtained which show the great services this instrument may render to navigation.

NATURAL HISTORY DRAWING.

PICTORIAL representations of animals, or zoological drawing, in most cases, is the best and the most general substitute for the animals themselves, and is highly conducive to aid the inquiries of the naturalist. If this is accompanied by a full and accurate description, without reference to any particular system or method, the subject can almost always be referred, with little danger of error, to its proper station in nature.

It is much to be regretted that, until very lately, zoological painting has been comparatively neglected. No principles were laid down by which drawings of natural objects could be rendered permanently useful or valuable to science; the delineation of those parts which did not immediately meet the eye in the general representation were omitted, while, if the coloring was faithful, and the general outline tolerably correct, both the artist and the naturalist conceived that every object was gained. Hence have arisen the numerous mistakes of authors respecting the identity of a bad figure, the misquotations of compilers, and the tedious complexity of unravelling synonyms. From this carelessness about detail, the drawings of many artists, celebrated in their day, have almost given rise to more error than information; while, as regards their scientific utility, they have become of little or no value.

In *zoological painting*, the first requisite, as regards its application to the purposes of science, is accuracy in the detail. In the higher departments of art, more particularly in landscape painting, it is only sufficient to imitate general appearances or effects, leaving the details—such as the form of leaves, the pebbles of a road, or the tiles on a house—to be filled up by the imagination. The same principle extends, though in a less degree, to historical design; and in both the fancy of the painter may, to a certain extent, be indulged. But in proportion as we descend to particulars, our imagination must be confined, and our accuracy redoubled. If the painter wishes to make his subject intelligible to a scientific observer, the smallest tooth of a bat must be rendered apparent; the exact shape of the scales on the foot of a bird,

and the spurs on the tarsi of an insect, must be exactly copied. It may be almost said, that no artist can hope to gain a high degree of perfection in zoological painting, without being himself a naturalist; or at least knowing, in a general way, what are those parts of his subjects which more particularly demand his attention. These we shall therefore briefly notice, as they regard the grand divisions of nature.

In *quadrupeds*, the profile of the head and of the muzzle, the direction of the ears, the form of the hoofs, the number and proportion of the toes, and the size and shape of the claws, are to be particularly attended to in delineating the general figure of the animal. The following parts should be given separately, and in detail:—Outlines of the teeth in the upper and under jaw; of the head in a position different from that in the general figure; of the toes and claws in a position best adapted for seeing their peculiar construction. Where practicable, outlines of the tongue and other internal parts are frequently of great interest.

In *birds*, the form of the bill, the length and disposition of the bristles with which in some tribes it is surrounded, the proportion which the length of the wings bear to that of the tail, the shape and direction of the crest of the head, where it exists, and of the scales on the feet, must be all expressed in the general figure. The details that should accompany ornithological drawings are many, and require the greatest accuracy. We may instance the fieldfare, to exemplify these more fully. An outline of the bill in profile, including the feathers and bristles immediately encircling the base; a vertical view of the same; the notch near the tip of the upper mandible; a transverse section of the upper and lower mandible, by which its relative thickness is seen; the nostrils and their lateral apertures; a leg including the toes, and claws; a wing, showing the relative length of the primary quill feathers, drawn from the inner surface and the termination of the tail feathers, taken in the same position. When recent specimens can be procured, the tongue should be represented laterally and vertically. All these parts should be drawn either the size of nature, or sufficiently large to be rendered clear and intelligible. Respecting the general figure of the bird, it is of little consequence on what scale it is represented, provided the proportions are accurately preserved; neither is it necessary that an artist, engaged in making a series of drawings, should attach these details to every species, when any two or more are found exactly to accord.

In *fish*, the relative position of the fins; the number of the rays composing each,—marking the distinction between such as are simple and hard or *spined* rays, and such as are jointed and branched or *soft* rays; the extent to which they are connected by the membrane; the form of any filaments or appendages terminating the rays placed on the head, or on other parts of the body; the position of the vent; and the relative length of the under jaw with the upper,—are peculiarities necessary to be attended to in designing the general figure. The details most desirable are, a front view of the head, sometimes a vertical outline of the same part, the gill covers, the teeth, and the tongue. For the lower vertebrated animals, as the serpents, reptiles, and amphibians, the head and teeth are those parts most necessary to be represented in detail: the former, in drawings of serpents, should always be

shown in a vertical direction, and form of the scales accurately copied. In these, and other oviparous quadrupeds, many of the generic characters are frequently taken from the scales, &c. on the under surface of the body; outlines of which are, consequently, important.

In *insects*, the parts to be given in detail vary according to the different tribes. As a general rule, however, the various organs composing the mouth, the antennæ, the palpi, &c., require to be represented as they appear when magnified; likewise a profile and front view of the head, and of the fore and hind legs. Insects are always drawn of their natural size, and, to be perfect representations, require to be finished in colors. Delineations of the larva and pupa of all insects are highly valuable; and regarding the latter, the greatest care should be taken in expressing the mode of its attachment to other substances, and whether the head is turned upwards or downwards,—as this is an important distinction among the diurnal butterflies.

In the radiated and inferior invertebrated animals, the variety in form is so infinite, that no particular rules can be laid down. In many tribes, dissection will be necessary to detect their true nature. Calcareous shells, which are the covering of mollusks, are among most beautiful objects, both for the cabinet and the pencil, that the amateur naturalist can select. In drawing these, the artist should pay great attention to the contour of the mouth, to the delicate striae that may appear on the surface, to the teeth or tubercles that may exist on the inner or outer lip, to the plaits or granulations on the pillar, and to the termination of the spire. In bivalve shells, it is generally necessary to represent the teeth in two, and sometimes three, points of view; particularly those which rise vertically; to these details may be added magnified representations of the hinge of small and minute species; but in univalves, the upper and under side of which are usually figured, no details are necessary. All marine animals, including the inhabitants of shells, may be drawn with peculiar advantage, if kept alive in a vessel filled with sea water. It is then only that they expand or protrude all their members, and they are seen by the spectator in different points of view.

Drawings, made on these principles, may be either *shaded* in one color, as in pencil or Indian ink; *tinted*, i. e. slightly washed with their natural colors; or *finished* and worked up to the closest resemblance to nature which art can produce. Now, it is evident that a knowledge of forms will be confined or extensive, in proportion to the number that may be possessed by the naturalist, either in his cabinet or his portfolio. To possess all animals is impossible; drawings, therefore, supply the place of the originals; and number, not quality, should regulate his views. Accurate sketches, slightly shaded, will frequently give him all the information he wants: and if these are tinted with their natural colors, it follows that the two first methods, just mentioned, of forming a series of zoological drawings, is decidedly the best.

And yet the *perfection* of zoological painting does not depend on producing an exact imitation of the object; for, however desirable this may be, it is, after all, but a mechanical operation. The next step is, to study those forms, actions, and habits peculiar to the individual in a state of nature, and select such as are most beautiful or appropriate, either for the display of color, or as strongly

characteristic of one or more individual properties. It is here that genius first enters into the subject. Every scientific object may be gained by copying, with exactness, a stuffed skin, as it is seen in a museum; but, after all, such a drawing will not represent nature. The gracefulness and beauty of her forms must not be studied through the medium of artificial preparations. To illustrate this, let the figures of quadrupeds in Buffon be compared with those of Landseer, or the plates of Edwards (*Nat. Hist. of Birds*) with those of Wilson (*American Ornithology*): the one, stiff, clumsy, and often distorted; the other, easy, graceful, and natural.

To correctness of outline should be added a thorough knowledge of light and shade, or rather those more delicate principles which produce effect. The zoological painter is tied down to color: he must copy the exact tone of every part of his subject; and cannot, therefore, avail himself of those diversity of tints for producing effect, which come within the privilege of the landscape and historical painter. Perhaps Van Huysum and Rachel Ruysch, in flower painting, excel all others: both are remarkable for the elegance of their grouping, the chasteness of their coloring, and the correctness of drawing. Van Huysum's notions of effect never extended beyond the light on a grape, and a dew-drop on a leaf: all parts were clearly made out, as if he only painted at noon. Rachel Ruysch, on the contrary, not only studied effect in particulars, but in generals; with all the delicate finishing of her rival, she possessed what he did not,—a depth and a relief, which, while it obscured one part of her pictures, gave a tenfold richness to the other. We have selected these two painters to illustrate our remarks, as their productions are well known; but the zoological artist will find that the works of Barraband and Audubon, the two most celebrated ornithological painters, will stand in precisely the same relation.

ETCHING-GROUND FOR ENGRAVERS.

THERE are few articles of more importance to copper-plate engravers than the compound commonly called etching-ground. As there are many recipes in existence, and several of them almost equally good, it is very difficult to make choice without considerable experience, and even then, however judiciously the materials may be proportioned, yet failure may take place, from the bad qualities of the ingredients, or an improper method of compounding them. The most important and indispensable material is asphaltum. There is no substance in nature that can completely supply its place; and, indeed, however good all the other materials may be, if this one is bad, nothing can be added to make up for its impurity. Asphaltum, or Jews' pitch, is a solid mineral bitumen, supposed by many naturalists to have originated from fluid petroleum, or mineral tar, inspissated by some natural process of evaporation. The tar that is obtained in the distillation of bituminous coal, by the common process of preparing coal gas, bears a considerable resemblance to petroleum, and if properly treated, by gentle evaporation, first forms a complete mineral pitch, and, by a continuance of the process of evaporation, it at last attains the consistence of asphaltum. This artificial asphaltum is found to answer nearly all the purposes of the natural production, as an ingredient in the

coarse black varnishes, such as are used for coach-tops and a variety of japanned wares, such as coal-scuttles, and most of the common iron articles that are required to be preserved from rust by the application of common and cheap varnish.

The artificial asphaltum has a fracture so nearly resembling the natural, that it is very difficult to distinguish them by mere external inspection; yet, generally speaking, the former is of a deeper black color than the latter, the best of the natural kind being of a fine deep dark brown color; it is used frequently as a glazing color in oil painting, and is likewise said to be the article which constitutes the basis of the cake color used in water-color painting, and known by the name of Vandyke brown. If a small piece of the artificial asphaltum be laid upon a hot iron, the vapour will be very nearly the same as that produced from a piece of coal placed in a similar situation, and a coaly cinder will remain behind.

The most certain method of detecting the natural from the factitious is by the smell. The products that arise with the tar, in the distillation of coal, and are more or less combined with it, are sulphur and ammonia; which substances, although very volatile in their pure state, have so strong an attraction for the tar as by no means completely to separate from it during its conversion into the artificial asphaltum; therefore, when we submit this substance to the test of hot iron, the ascending vapour has always a nauseous odour, in which both sulphur and ammonia may be distinguished. The presence of these substances in the artificial asphaltum made from coals, evidently renders it very unfit for the purpose of making etching-ground; because, as dilute nitrous acid is used to corrode the copper plate, in the process of *biting-in*, the well known affinity of the acid for the alkali will cause a decomposition of the etching-ground, and shallow or rough bitings will be the consequence. Also, etching-ground made of such asphaltum will sometimes act slightly upon the copper plate, if the ground should be left upon it for a considerable length of time, and a stain will be produced upon the surface, productive, in some cases, of much evil in the process of *biting-in*. These observations will be deemed sufficient reasons why the artificial asphaltum should be rejected in making etching-ground.

When a small piece of genuine Syrian asphaltum is placed upon a hot iron it will, if it be very good and pure, be nearly all converted into vapour, the smell of which is by many persons considered to be agreeable. The essential oil of turpentine dissolves it completely, and forms a liquid varnish that resists the action of dilute nitrous acid. Hence some engravers use it to cover the etched lines on copper plates that have been sufficiently corroded by the nitrous acid in the progress of *biting-in*.

The above-mentioned properties that pure asphaltum possesses, of resisting the action of dilute nitrous acid, and also of giving hardness and toughness to etching-ground, render it completely indispensable, and consequently an ingredient of the very first importance.

The second, and scarcely less important substance, is Burgundy pitch. This is obtained from the *pinus abies*, or Norway spruce-fir tree. After the resinous matter is collected from the tree, which is done by incision, it is boiled in water, strained through a linen cloth, and packed in casks or bladders for exportation. It is chiefly prepared in the

neighbourhood of Neufchatel, and comes to this country through Saxony. The best for making etching-ground is sold in bladders, and when perfectly good is of an opaque yellow, rather darker than straw color. By age it becomes superficially transparent, and at the same time, probably by the loss of its essential oil, becomes so brittle as to be rubbed down between the fingers. That which is the most recent, and therefore opaque, is the best for the engraver's use, as it effects a more complete solution of the asphaltum.

The third and last article is virgin-wax. That which is brought from the East Indies is, in general, the best. Most of the English wax is adulterated with deers' suet, which makes it very unfit for the purpose of making etching-ground, because it destroys the toughness and adhesion of the ground to the copper plate. This adulteration may be very easily detected by its softness and clamminess to the feel, and also in its being less transparent when interposed between the eye and the light. If the surface of fine wax be rubbed with a linen cloth, it will take a considerable polish, or gloss, while that which is adulterated will be comparatively dull. If thin shavings are cut with a sharp clean knife from genuine wax, the edge of the knife will leave a fine polished surface where the shaving is separated; but wherever adulteration with suet has taken place, the polish will be proportionably wanting. As these three ingredients (when pure) are all that are necessary to make good etching-ground, it is quite useless to multiply the number. Asphaltum, it has been stated, is indispensable, and therefore must be had at any price. The other articles may be obtained without difficulty.

Directions for the preparing and compounding the ingredients.—The asphaltum must be broken into small pieces, and if any pieces of clay or other impure matter are observed, they must be carefully taken out, and then it must be ground very fine in a marble or Wedgwood-ware mortar; and while it is under this process, if any hard stony material is discovered it must be carefully taken out; it will then be ready to be mixed with the other materials, in the following manner:—Put 4 ounces of Burgundy pitch into a well glazed pipkin; let it melt gently over a slow fire, and move the pipkin round, so that the whole internal surface may be covered with the melted pitch. Then add 4 ounces of the ground asphaltum, and let the pipkin remain upon the fire until the two substances are tolerably well mixed, which will soon be effected if the mass be well stirred. Then add 4 ounces more of the asphaltum, and if the heat be increased, and the mass well stirred, the whole may be incorporated, and will be nearly as fluid as melted pitch. When the asphaltum appears to be thoroughly melted, it should be kept in that state for at least a quarter of an hour, the heat being a little lowered, but it must be stirred all the while, by which means a large portion of the moisture of the Burgundy pitch will become evaporated; and the essential oil of the pitch will be thoroughly incorporated with the asphaltum, and render the etching-ground more perfect; for when this is omitted, evaporation takes place from the ground when spread upon the plate, after it has been laid on for a month or more, and sometimes in a shorter time, a circumstance which very often produces considerable difficulty to engravers; because when that takes place, the ground

is rendered brittle, and chips or flies from the plate, to the great detriment of the tints or lines ruled upon it. When the asphaltum and Burgundy pitch are thus prepared and incorporated, add 6 ounces of the best virgin wax, and keep the whole well stirred till it is completely mixed, and let it simmer gently for about ten minutes, when it may be taken from the fire and suffered to cool until it is of the consistence of turpentine, or very thick treacle, and in that state it may be poured out upon the clean surface of a copper plate, or well glazed earthenware dish, in portions sufficient to make a ball, which may in general weigh about an ounce, and when it is sufficiently cold, it must be rolled up into balls by the hands, and kept perfectly clean for use, provided it is found upon trial to be of the proper consistence; but this cannot be judged of until it has been laid upon the plate for a few hours. If it is too soft, the etching point will make the lines of unequal breadth, or, as they are technically called, they will be drag-lines, being in some parts very fine, and in others very gouty or thick. If it is too hard, the etching point will cause the lines ruled on the ground to chip, and then the edges will be notched or serrated, which would be very prejudicial to the appearance of fine even tints. There is also another property that may be wanting where the proportions are not properly adjusted, namely, that of spreading kindly on the copper plate. This fault in ground may be easily remedied by the addition of a proper quantity of Burgundy pitch.

Asphaltum makes the ground hard and tough, therefore if it wants that quality, more asphaltum must be added, but it must be previously dissolved in a proper proportion of Burgundy pitch, for otherwise it will be very difficult, if not almost impossible to get it thoroughly incorporated, after the virgin wax has been added.* The propriety of this caution will be evident, when it is considered that Burgundy pitch is the *real solvent* for the asphaltum, and must therefore at all times be incorporated with it first; and for this reason it will always be the best way to make the ground rather too hard than too soft, because it is much easier to soften it than to make it harder. Should the ground upon trial be found too hard, a small quantity of virgin wax may be added, which is all that is necessary to answer that purpose. If upon trying to lay it upon the copper plate it does not spread kindly, but clings to the dabbler and only partially covers the surface of the copper, this fault may be remedied by adding a small quantity of Burgundy pitch; but should this property prevail, and the ground also appear upon trial too soft, then Burgundy pitch and asphaltum must both be added, after they have been thoroughly incorporated together; for the principal circumstance to be attended to in making etching-ground, is completely to dissolve the asphaltum.

From what has been stated above, the following general rules or principles are deduced:—First, that asphaltum gives hardness and toughness to etching-ground, and is indispensably necessary, on account of its valuable property of resisting the dilute nitrous acid. Secondly, that Burgundy pitch acts as a solvent for asphaltum, and when mixed, is a vehicle to spread the ground over the copper plate, which is necessary to prevent foul biting. Thirdly, that virgin wax softens the ground, and gives it such a consistence as secures the beauty of etchings.

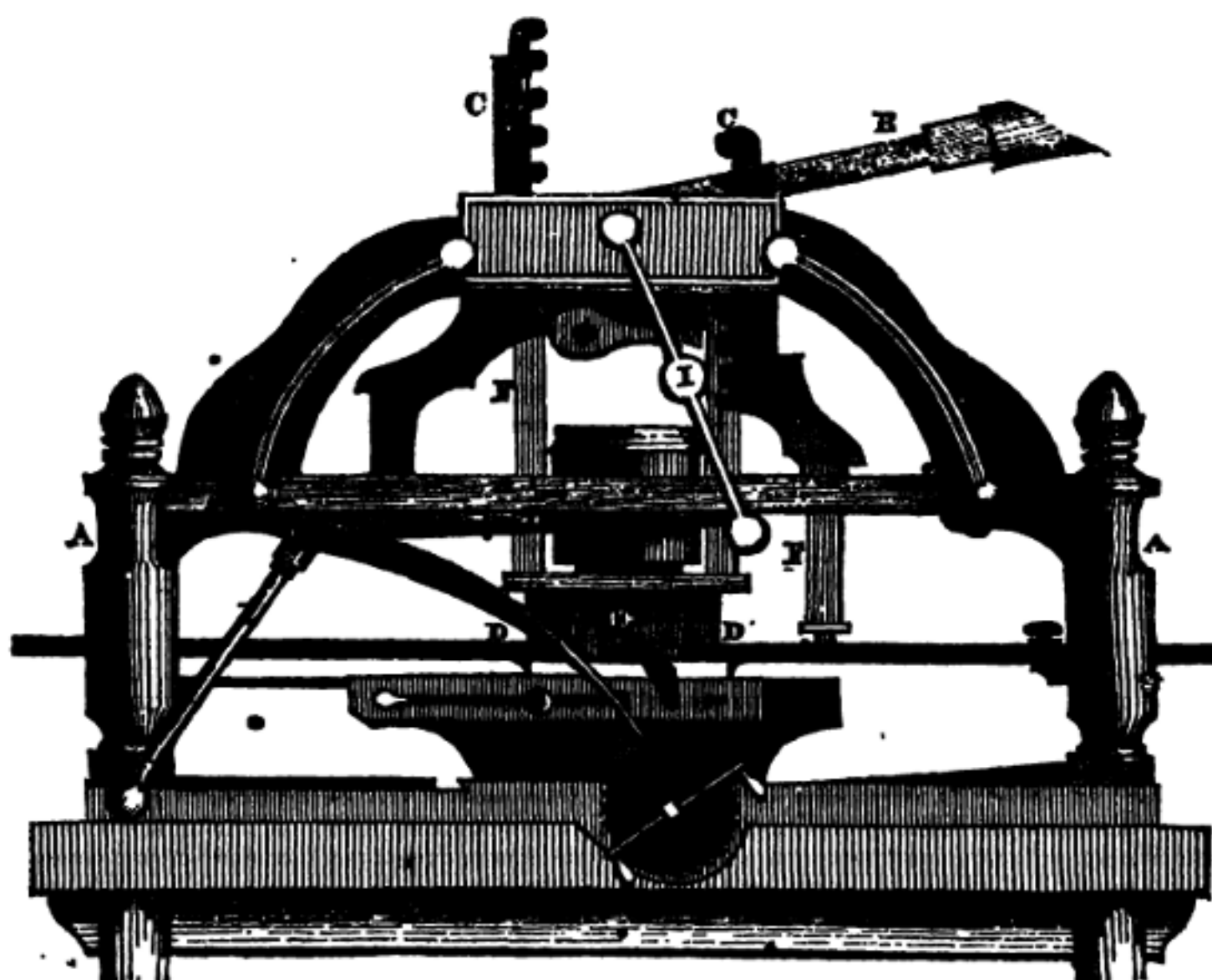
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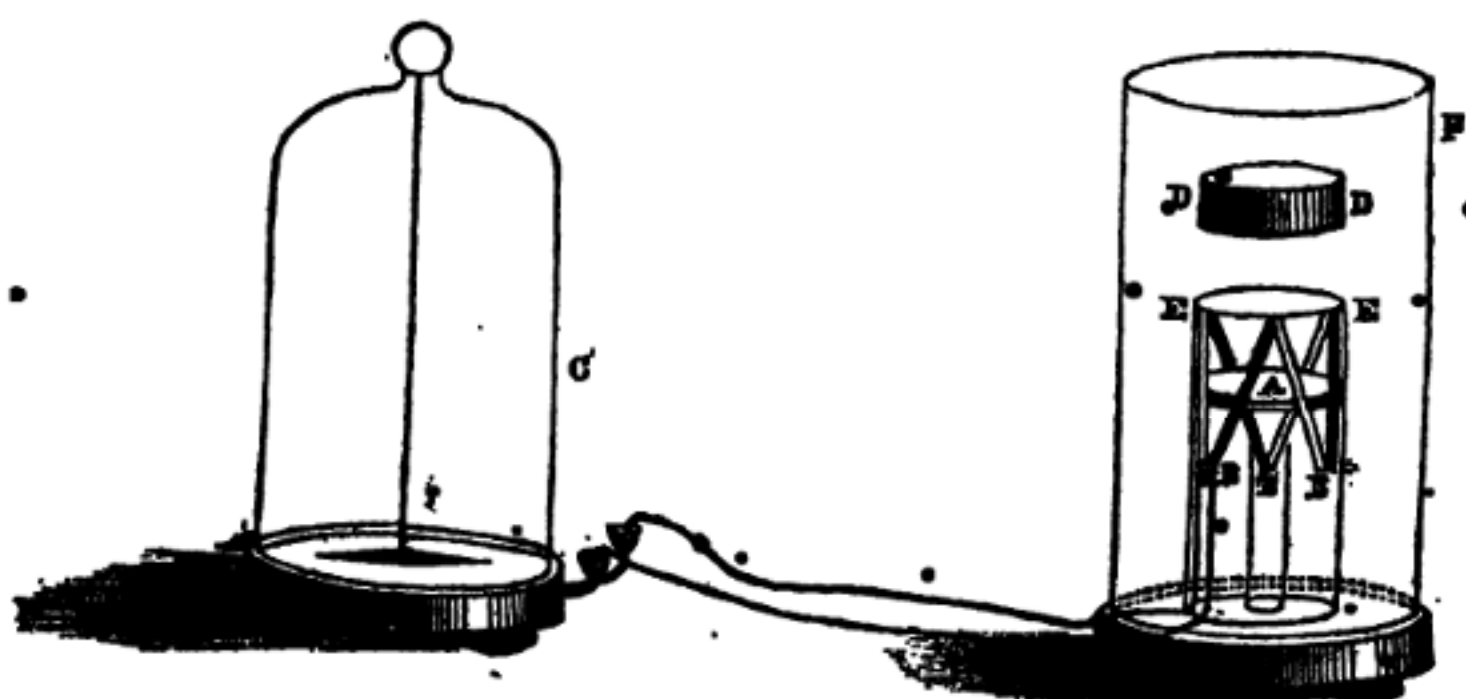
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SATURDAY, JULY 23, 1842.

[1½d.]



COMB MAKING MACHINE.



PELTIER'S ELECTRIC HYGROMETER.

COMB MAKING MACHINE.

THE process of comb making is usually conducted as follows:—The material of which the comb is formed is first reduced to thin smooth plates of an even thickness. The workman who cuts the teeth then fastens one of these plates in a clamp or vice, and proceeds to cut the teeth by means of a double saw, of which each blade is somewhat like the small one with which joiners and cabinet-makers cut their fine work. As this instrument leaves the work square, and in rather a rough state, particularly in the inside edge of each tooth, it is followed by another about the size and shape of a case-knife, having teeth like a file on each flat side. After this, two others of the same shape, but each finer cut than the former, follow. One stroke on each side of the comb is then given with a rasping tool, to take off any roughness that may remain on the sides of the teeth, after which they are polished by rubbing them with rotten stone and oil, spread upon a piece of buff leather. With the simple apparatus above described, delicate ivory combs, containing from fifty to sixty teeth in the inch, are cut. Mr. Bunday's machine, which is the usual one for cutting the teeth of combs is constructed as follows:—Upon an arbor driven by a treadle is fixed a number of circular steel cutters, corresponding to the notches intended to be cut in the comb. These cutters, which are about two inches diameter, and all exactly equal in thickness, have brass washers between them, and are also kept regularly asunder, just above the place where the comb enters, by steel guides fixed in a stationary frame. The comb is firmly secured to a horizontal sliding block or carriage, which is made to advance towards the centre of the axis of the cutters, by means of a screw turned either by hand or by a hand-wheel fastened upon its axis. The combs are pointed by applying them to an arbor, driven by a crank, and clothed with cutters with chamfered edges.

Some improvements have been introduced in the rotatory comb cutting machines by Mr. Lyne, who has also invented a machine by which two combs are cut at once out of any tough material, as horn or tortoiseshell: the parts cut out from between the teeth of one comb forming the teeth of the other comb; by which means the waste of material occasioned in cutting combs by the ordinary process is avoided. This machine is represented in the accompanying engraving. A A is the frame of the machine, made of cast iron; B, a lever, which, by a pinion upon its axis, gives an alternating motion to the racks C C; E is the cutter in its carriage, which is attached to a strong helical spring, contained in the cylindrical box, and is seen immediately over it. At each extremity of the cutter is a small chisel D D, set upon sliding rods, so that their distance asunder may be always equal to the length of the cutter E; these chisels make the end cut, by which the teeth of one comb are separated from the back of the other comb. Beneath the cutters is a traversing carriage; upon which the horn or tortoiseshell is firmly secured by screws: it is made hollow to admit of a heated iron being introduced within it, in order to soften slightly the horn or tortoiseshell, and render it less brittle. This carriage is advanced along a chase mortise, fixed upon the bed of the machine by means of a screw, upon one end of which is a ratchet wheel, which is moved by the compound levers I I I. The fineness of the teeth of the combs is regulated by the teeth in the ratchet

wheel, which is accordingly changed with the nature of the work, and a handle is placed on the axis of the ratchet wheel for the purpose of bringing back the frame after a comb has been cut. The operation of the machine is as follows:—The alternating motion of the lever B backwards and forwards alternately raises and depresses the racks C C; the horns or curved projections in the middle of these racks bring down the cutter E, by which one side of a tooth is cut, whilst the extremities of the racks depress one of the chisels D, which makes the cut at the end of the tooth. The cutter E is returned during the rise of the rack, by the spring contained within the cylindrical box, and the chisels D by the spring of the rods upon which they are set. In order to give the tapered form to each tooth, and to reverse them successively upon the opposite side of each of the racks to that shown in the engraving, is a small inclined plane or cam, which, on the descent of the rack acting upon the vertical bars F F attached one to each end of the cutter frame, causes the cutter to change its position, and to make angular, instead of parallel incisions.

PELTIER'S ELECTRIC HYGROMETER.

THIS is a singular instrument, and one so little known, that we venture to offer an account of it to the English reader, the original appearing in *Becquerel's Traité d'Electricité*. It is founded upon the principle that the cold produced by evaporation is an indication of the dryness of the air; the greater the cold the greater the evaporation, and consequently the drier the air. The reduction of temperature is measured by a thermo-electric apparatus, represented in the annexed figure, B B B, three couples of bars of antimony and bismuth, forming a thermo-electric pile; A is a disc of wood by which it is sustained, being fixed by a screw attached to the lower part of the apparatus; E, a cylinder of card; F, a receiver covering the whole apparatus; C, the galvanometer, the needle only being seen; D, a small capsule of platinum containing distilled water, in which the evaporation takes place that produces the cold. The bars in this pile are thrown into the form of a crown that they may support the platinum capsule, and be placed in contact with it. When it is brought into action, it must be freely exposed to the air subjected to experiment, but protected carefully from the influence of currents by the receiver, and from the radiation of external objects by covering the receiver with paper. It is obvious that the superior extremities, on which the capsule is placed in taking observations, must be exposed to a reduction of temperature according to the amount of evaporation, when the galvanometer will be proportionally affected.

BRITANNIA METAL WARE.

THE general disuse of the old pewter ware, once so common in this country, has been followed by the introduction of another metal, in the manufacture of which a degree of ingenuity is constantly displayed, to which the ancient pewterers were altogether strangers. The modern material, the base of which is tin, has been called Prince's metal, more commonly Britannia metal, and by the workmen white metal. It is not only wrought into all the variety of elegant and useful articles to which silver is applied, but, along with its capability of receiving

almost every modification of which that precious metal is susceptible, it also very much resembles it in color and brilliancy. It possesses also, when quite new, and in some articles of a fine quality, candlesticks in particular, an effect which an inexperienced eye might easily, before the metal became common, have mistaken for silver. The beauty of this metal, when wrought into a variety of articles, is not, more striking than its cheapness in the manufactured state is surprising. This latter circumstance results, independently of the price of the material itself, from the extensive application of machinery, and the extreme lightness of body with which wares in Britannia metal can be produced; a lightness, however, which is always obtained at the expense of durability, as well as of shape. A quart tea-pot, for example, of a most elegant pattern, mounted on four balls, and flourished with engraving, may be bought in the shops for so trifling a sum as three or four shillings; and hence, nothing is so common in an ordinary tea-table display, among even the middle classes, as an utensil of this description: and almost as common is it, in those cases where cheapness has supervened, to find the article sadly bulged and warped from its original symmetry; an effect which the hot water therein used, along with the constant lifting and placing the pot upon the table, unitedly produce in a very short time, when it is of such a flimsy make.

The principal, if not, indeed, the only seat of the manufacture of this metal, is in Sheffield, where its composition and application on a large scale was begun about the year 1770, by two individuals of the names of Jessop and Hancock. Its conversion into a great variety of beautiful wares probably gives employment to about 500 individuals in that place.

The composition of Britannia metal is as follows:— $3\frac{1}{2}$ cwt. of best block-tin; 28 lbs. martial regulus of antimony; 8 lbs. of copper, and 8 lbs. of brass. The amalgamation of these metals is effected by melting the tin, and raising it just to a red heat in a stout cast-iron pot or trough, and then pouring into it, first the regulus, and afterwards the copper and brass, from the crucibles in which they have been respectively melted, the caster meanwhile stirring the mass about during this operation, in order that the mixture may be complete. The fusion of the whole being completed, by the continued application of the fire for a short time under the pot, the liquid metal is, in the next place, transferred therefrom, by means of large iron ladles, to the casting-boxes, which are composed of cast iron, and give to the metal poured into them the form of a slab 15 inches long by 6 inches wide, and 1 inch thick. It is likewise put into other moulds, forming small ingots, for the convenience of being used in the casting of such articles as are not made out of the sheet metal.

The rolling or flattening of the metal into sheets, is performed exactly in the manner practised in the lamination of metals generally, that is, by passing it repeatedly between polished steel cylinders. The metal, although possessing some degree of hardness, is not susceptible of being softened or annealed by any process during the operation of rolling: and it becomes somewhat shattered or cracked along the edges. To prevent as much as possible this evil, the ingot is not rolled cross-way, so as to form a broad or square sheet, but simply elongated, retaining as nearly as possible the original breadth. Considerable attention is exercised in keeping it to

the exact thickness required; and for this purpose, the gauge is repeatedly applied; for, so nicely are the trade prices balanced against the value of the metal and the cost of manufacturing, that a very slight deviation from the proper size may make all the difference between profit and loss upon the sale of the articles.

Although, as already stated, almost every article manufactured in silver has now its counterpart in Britannia metal, the greater part of the material used is in the production of candlesticks, tea-pots, coffee-biggins, and all kinds of measures for liquids. The feet of candlesticks, and the bodies of tea-pots or other vessels, when presenting embossed work, and of any other than a circular form, are made by means of dies in which they are stamped. When the shape of the article is cylindrical, and ornamented with raised work, it is sometimes stamped in halves which are afterwards fitted and soldered together, or, when globular, it may be stamped in three or more pieces, according to the depth of the work or size of the article. The machinery of the stamp, and the mode of working it, resembles those employed in the manufacture of brass and silver, hereafter to be described: there is, however, one important difference in favor of the working of the metal now under notice. In the stamping of brass work, unless the articles happen to be very large and coarse, and in performing the same operation with silver, and plated metal especially, the dies are not only required in almost every instance to be made of steel, but the figure of the article designed by the artisan has to be cut in them at great labour and expense; so much so, indeed, that the die-sinking, and the metal upon which it is expended, constitute one of the heaviest items of expense in manufactories where the above-named metals are wrought. And this expenditure is greatly enhanced, not by the wearing of the dies when finished, but by the continual demand for new patterns. The Britannia metal worker has a readier method. He either forms a model of his article, when the design is new, or, what is more frequently the case, having obtained some fashionable silver plated article, he takes it to pieces, and from the stamped parts he casts fac-similes in plaster of Paris, and from the matrices thus produced, a counterpart, in relief, is moulded by a similar process and of the same material as in the first instance. Upon this model is ultimately cast the die, of fine hard pig-iron; and which, after having been got up with emery, and perhaps slightly retouched, to give sharpness in some of the lines, with a steel tool, is ready for use. In the making of dies for round or oval-shaped articles, the adoption of this method is of less consequence, as the turning of them at the engine is easy and inexpensive. Indeed, so tractable is the metal, particularly when very thin, that in this state it is often stamped in dies made of brass, and even of spoon metal.

The bodies of those tea-pots which are of a globular form, or which exhibit concentric and circular swells, are mostly made by a curious operation, technically called *spinning*. In the performing of this work, steam power is generally used at the larger establishments; but it is rather by great manual dexterity than by means of intricate machinery, that the workman produces such amazing and rapid transformations of the tractable substance upon which he operates. Upon a spindle, rapidly revolving in a horizontal position, is fixed a wooden chuck, or model of the pot or other article to be

formed; or rather of so much of it as will allow the metal to slip off the wood after it has been closed upon it. A piece of sheet metal is cut with shears into a circular shape, and of the size required: this is placed against the end of the revolving chuck, and against the metal outside is applied a circular bit of wood, having an indentation in the middle, where a centre pin of obtuse form is screwed firmly upon it: thus placed, and while it rapidly spins round, the workman applies various tools, either of hard wood or of polished steel, in the first place very gently, until, by a succession of touches, he bends the plate over the model-chuck without either crumpling or laceration. The article is afterwards placed in a similar manner against another chuck, and the spherical or other form perfected. Some of these articles are partly formed by a stroke in a die previous to the spinning: in others, in which the metal is made to overlap the model, the latter is composed of segments, so as to be removable on the withdrawal of the middle piece, somewhat in the manner of a boot-last. In general, however, vessels intended to be perfectly spherical, are executed only in halves, or even smaller portions at a time. This manipulation, like that of forming a vessel of clay on the potter's wheel, would be quite beside the reach of an unpractised hand, yet there are individuals, who have been long accustomed to the work, who can spin twenty dozens of these pot bodies in a day!

The fluted work put in obliquely, or at right angles to the circular design of many utensils, and which add at once so greatly to their strength and beauty, is performed by means of a large fly-press; one workman applying the metal between the punch and boss, properly formed for making the impression, while another keeps swinging backward and forward the weighted lever arm of the machine. Embossed ornaments, of a character of elegance little, if at all inferior to those displayed on silver plate, are commonly applied to the superior products of this branch: the practice has of late years been introduced of making these ornaments of silver stamped in sheet metal exceedingly light.

In the manufacture of Britannia metal articles, a soft solder is used, consisting of fine tin, alloyed with about 30 per cent. of lead; this is rolled into sheets, about the thinness of common tin, and then cut into slips for the convenience of holding and application. In using this solder, the seams of the metal, where the joining is to take place, are scraped clean, and then smeared with a composition of melted rosin and oil: the flame of a candle is then made to play upon the part, by means of a small blowpipe, held in the mouth of the workman, while he holds the article under the operation in one hand, and applies the slip of solder with the other. Extreme caution is required in the management of this affair, especially when the metal is thin, in order to avoid melting the body as well as the solder.

GOTHIC MOULDINGS AND ORNAMENTS.

THE mouldings, projections, and ornaments of Gothic architecture seem to have very little connection with those of the Greeks and Romans; and if any similarity exists, it appears rather the result of accident than design; especially as we can trace both styles of building from their origin to their perfection, and both appear throughout unconnected with each other. The classical pro-

ceeded from the rudest and most massive Doric, or rather Cyclopiian, to the chaste and elegant Ionic and Corinthian. The Gothic gradually developed itself through many ages; assuming first the rude style of the Saxon, or more properly *Early Norman*, as Malmesbury Abbey, 1180; then the *transition*, like Christchurch, Oxford; or St. John's at Devizes, which merged into the *Early English*, of which we have such splendid examples in Salisbury Cathedral, Wells Cathedral, St. Saviour's Southwark, and Temple Church London. Then followed the *decorated* style, as in York Cathedral, Lichfield Cathedral, Gloucester Cathedral, &c.; and finally it reached its perfection of beauty in the Tudor or *perpendicular* style, and of which Henry the Seventh's Chapel at Westminster, Lincoln Cathedral, and Westminster Hall, may be cited as examples.

It is to be expected that these various styles should have their appropriate mouldings and ornaments; in fact, we even find the latter characteristic of the respective times of the buildings. The most common moulding of the Norman architecture was the *cheveron*, or zigzag, seen below.



Indeed, so common was this enrichment, that it is considered quite characteristic of this style, though sometimes continued after the introduction of the pointed arch, through the whole of the period of tradition. In the earlier buildings, it is usually in single or double rows; at a later period, triple and quadruple, and occasionally reversed, as follows:—



Haddiscoe Church, Norfolk.

The capitals of the pillars of this period may justly be considered as but rude attempts at beauty. The *cushion capital*, as given beneath, illustrate their particular character.



The walls were wanting in the rich tracery of the Decorated Gothic, and equally in the simple boldness of the Early English, but the sameness of a long flat space was much and very elegantly relieved by intersecting arches; in the earlier ages round, in the later they assumed somewhat of a pointed form, gradually merging into the lancet arch. The following shows the general character of these intersecting arcades:—



The projections of the Norman buildings were by no means prominent, but its ornaments adapted to flat surfaces extremely numerous, and mostly of a rude and sometimes a grotesque character; this, also, is the case with Transition buildings, and with Early English. The Cathedral at Rochester abounds with grotesque figures, brackets, bosses, and pendants. In the older buildings, the billet, the nail-head, the scallop, and the trowel-point ornament were more or less common.



Billet.—Binham Priory, Norfolk.



Nail-head.—Ely Cathedral.



Scallop.—Castor Church, Northamptonshire.



Trowel-point.—Norwich Cathedral.

At a later period when we may suppose that our rude ancestors had acquired greater skill in sculpture we find attempts at greater beauty and variety. Hence we have at this period the following ornaments.



Embattled.—Sandwich Church, Kent.



Beak-head.—St. Ebbe's, Oxford.



Cat's-head.—Tickencote Church, Rutland.



Pellet.—Wenlock Priory.



Cable.—Romney Church, Hants.

Others, almost endless in number, might be adduced, particularly in the later and more enriched examples. Still we find little which has the appearance of foliage or flowers, until the time of the Early English style. In this the mouldings are cut with great boldness, as will be seen from the following moulding from Shere Church, Surrey, built about 1240 :—

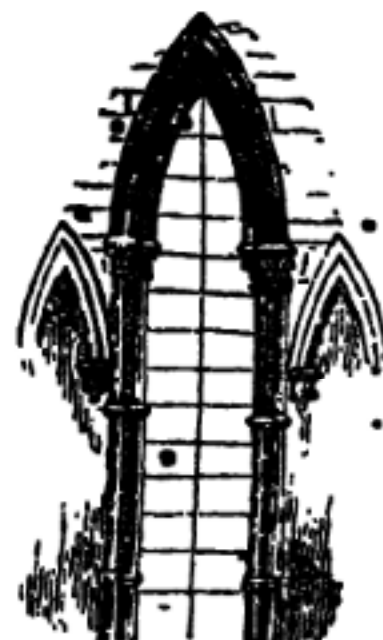


The *Toothed* ornament is frequent in the mouldings of this style, and is one of its chief distinctions, being rarely found in any other :—



Toothed ornament.—Ketton Church, Rutland, 1240.

The mouldings, as will be seen by the above specimen, consist chiefly of bold rounds and hollows, in juxtaposition with each other, with very few square members intervening, and those of slight importance or size. The capitals of the pillars, which in the Norman were square, in this style were more often round, and sometimes decorated with a foliage of considerable beauty, as at the Church of Stockbury, in Kent, built 1220. Arches, doorways and windows, previously made semicircular, now assumed the lancet form, with more or less of tracery in the upper part of them. The following is an early



specimen. Flying buttresses, battlemented copings, tall spires ornamented with crockets and finials, were now first introduced.

(To be continued.)

MANUFACTURE OF DRAWING BOARDS.

THE manufacture of stout and beautiful drawing boards has occupied the especial attention of Mr. Steart, of De Montalt paper-mills, Coomb Down, near Bath, who received an honorary medal from the Society of Arts, Manufactures, and Commerce, for the communication of his process, which we have abridged as follows, from the *Transactions of the Society*.—The extra stout drawing papers, or card boards, as they are usually denominated, are always made by pasting several sheets of paper together in the manner of a common pasteboard, and afterwards bringing them to a smooth face, by pressing and rolling. The pasting is a dirty operation, and the occasion of many defects, some of which are fatal to the degrees of perfection and nicety required in a good drawing board. Another great defect is, that the far greater part of the drawing and writing papers now in use in this country are of a hollow or spongy texture; this arises from their being made of an indiscriminate mixture of linen and cotton, the greater elasticity of the latter preventing its fibres from closely uniting with those of the wax; the consequence is, an irregular surface, and a porous, spongy substance, very different from that which an adherence to the good old-fashioned practice, of using fine linen rags only in the manufacture of superior papers, would produce. The drawing board of Mr. Steart is entirely free from these objections for the following reasons:—first, it is not composed of several sheets pasted together, but is moulded from the pulp of any required thickness, in one entire mass; thus the risk of pasting is avoided, and no separation of the component parts can possibly take place, though wetted ever so often; secondly, instead of being composed of linen and cotton, it is wholly and solely manufactured from the best and purest white linen rags, most carefully selected, and, consequently, without the aid of chloride of lime, or any bleaching process whatever.

The process.—In selecting the raw materials for the manufacture of the lino-tablets, as Mr. Steart has called them, great care is taken to preserve the best and purest white linen rags only, rejecting all muslins, calicoes, and every other article made of cotton. The linen rags are then carefully sorted, overlooked and cleaned, washed, and beaten into pulp, in the usual manner practised by paper-makers of the first class. The pulp being ready, and diluted in the vat with the proper proportion of pure water, the workman, dipping his mould first into the vat, takes it up filled with pulp to the top, and holding it horizontally, and gently shaking it, causes the water to subside, leaving the pulp very evenly set upon the face of the mould; having rested it for a moment or two upon the bridge of the vat, the compressor, with its face downwards, is now carefully laid upon the sheet or tablet, and both together placed in the small press close at hand, where it is submitted to a very gentle pressure, in order to exclude a great proportion of the water remaining in the sheet; it is then withdrawn; the compressor and the frame are then both taken off, and another workman turns it out by very dexterously turning the mould upside down, and pressing it pretty hard with his hands on one of the fine felts previously laid upon a very level pressing plank, by which means the tablet is left on the felt. The mould is then returned to the vat-man,

who repeats the process as before: the coucher, in the mean time, lays another felt upon the sheet or tablet just couched, whereon the second sheet is to be laid in the same manner, and so on until all the felts are occupied; over which another level plank is placed, and the whole drawn away on a small rail-road waggon to the great press, where it undergoes a pretty severe pressure.

The tablets will now be found to have sufficient adhesion to bear handling with care, and are separated from the felts, and placed one upon another, so as to form the packs; these packs are to be submitted again to the action of the press, until more water is expelled; then are parted sheet by sheet, pressed and parted again; and this is repeated as often as is necessary, taking care to increase the pressure every operation, until the face of the tablets is sufficiently smooth; they are then carefully dried, sized, picked, sorted, &c.: carried to the rolling mill, and several times passed between the polished cylinders, to give them the last finish.

The above is the process for the plain or white tablets. In making the tinted tablets, the following additional particulars are to be attended to. The rags are cleansed, washed, and beaten, in the usual way; the water being drained off, the pulp is put into a vat with a solution in water of acetate of alumine, or sulphate of iron, as a mordant or ground to fix the color intended to be made; the whole is well incorporated, and suffered to remain for half an hour or more, when the coloring tincture, previously prepared, is added; after which the whole being returned to the engines, is beaten into fine pulp, and then wrought into fine tablets. The dyeing materials, chiefly made use of by Mr. Steart, are mangrove bark, quercitron bark, best blue Aleppo galls, sulphate of iron, and acetate of alumine. A due combination of these materials produce a great variety of drabs, greys, sand-colors, &c.

ALKALIMETRY.

At present consists in an estimative process dependent upon neutralization, and the use of the test papers; the object being to ascertain the quantity of free alkali or of carbonate, contained in any impure specimen, as for instance, in that produced by the first rough process for their preparation. Descroisilles first resorted to neutralizing power for this purpose, but the extent to which the application has been improved by chemists since his time may be seen in modern works.

Let a tube, closed at one end and about three-fourths of an inch internal diameter, and nine inches and a half in length, have 1000 grains of water weighed into it; then let the space it occupies be graduated into 100 equal parts, and every ten divisions numbered from above downwards. At 23.44 parts, or 76.56 parts from the bottom, make an extra line a little on one side, or even on the opposite side to the graduation, and write at it with the scratching diamond *soda*; lower down at 48.96 parts, make another line, and write *potash*; still lower at 54.63 parts, a third line marked *carb. soda*; and at 65 parts a fourth, marked *carb. potash*. It will be observed that portions are measured off, beneath these marks, in the inverse order of the equivalent numbers of these substances, and consequently directly proportionate to the quantities of any particular acid, which will neutralize

equal weights of the alkalies or their carbonates. The tube is now completed, except that it should be observed whether the aperture can be perfectly and securely covered by the thumb of the left hand, and if not, or if there be reason to think it not ultimately secure, then it should be heated and contracted until sufficiently small.

Diluted sulphuric acid must now be prepared to be used with the tube. When of a specific gravity of 1.141, it will be very nearly, if not accurately, of the strength required; and this may be obtained by mixing one part of oil of vitriol of specific gravity 1.849, with four parts of water. If, when cold, the specific gravity of this diluted acid be as above mentioned 1.141, it must be nearly, if not exactly, of the strength required; but before being admitted into use should be examined experimentally. Assuming it however as being absolutely correct, it will be found that a quantity measured into the tube up to any one of the four marks described, is sufficient to neutralize 100 grains of the dry alkali or carbonate set down at the mark; consequently if water be added in the tube, thus filled up to any one of the marks, until the 100 parts are full, and the whole uniformly mixed, one part of such diluted acid will neutralize one grain of the alkali or carbonate named at the mark, up to which the acid of specific gravity 1.141 was first filled.

When a specimen of potash, or barilla, or kelp, is to be examined by this instrument, 100 grains are to be weighed out, dissolved in warm water, filtered, the insoluble portion washed, and the solution added to the rest; by this process the alkali will be separated from carbonate of lime, or other insoluble matters, which otherwise might cause errors in the estimation. The alkaline solution is to be put into a basin on the sand-bath, and then the tube and acid prepared. For this purpose some of the acid, of specific gravity 1.141, is to be poured into the tube until it rises up to the mark indicating the substance to be tested for; potash or carbonate of potash for the potash or pearlash of commerce, and soda or carbonate of soda for barilla or kelp: then water is to be added, until the hundred parts are filled, and closing the tube with the finger, its contents are to be perfectly agitated and mixed.

The alkali in the basin is now to be neutralized with the acid in the tube. After having once placed the thumb of the left hand over the aperture of the tube, it is not to be again removed; but inverting the tube by turning the hand so that the thumb and the mouth of the tube are downwards, the acid is to be let off gradually into the alkaline solution, by relaxing the thumb and admitting a succession of small bubbles of air; the hot solution beneath is to be continually stirred, so as to mix the acid instantly with the whole, and the operator must proceed with increased caution as the point of neutralization is approached. Very small quantities of the acid may be added, by slightly relaxing the thumb so as to permit a minute quantity, less than a drop, to flow to its extremity, and touching it with the glass rod; the final adjustment may thus be made more accurately, than by dropping the acid from the lip of the tube. The process must be thus carried on, until the alkali is found by the test papers to have been exactly neutralized: then the tube must be inverted, the thumb removed, drawing its under surface over the edge of the tube, so as to leave as much as possible of the fluid that otherwise might adhere to it, and having allowed the sides to drain, it must be observed how many

parts of acid have been used, the number of which will indicate the number of grains of the alkali or carbonate, contained in the 100 grains of the impure alkali operated with.

With respect to the proper strength of the acid, it is to be examined in the following manner:—crystals of bi-carbonate of potash are to be fused in a platina crucible, the fluid poured out upon a clean, cold metal plate, and a piece of the resulting solid, estimated to be 70, 80, or 100 grains, weighed in water; in this way a known weight of pure carbonate of potash will be obtained in solution. The solution is then to be diluted, heated, and neutralized by acid from the tube diluted as before described, from the mark of carbonate of potash. If it be found that as many parts of the acid have been used as of grains of the carbonate weighed out, the acid is of proper strength: if more acid has been used, it is too weak; if less has been sufficient, it is too strong. Suppose for instance that 100 grains of the salt (fused carbonate of potash) had been used, and that 90 parts of the acid were sufficient; then these 90 parts ought to have occupied the 100, and consequently the 100 parts contain one-tenth too much acid, in consequence of the experimental acid itself containing one-tenth more than it ought to do. Hence the latter must be diluted with such a quantity of water as will make nine volumes into ten, or by one-ninth its volume; for as the 90 parts used are to the 100 parts they ought to have occupied, so is any number of parts by volume of the acid under trial, to the number of parts which it ought to occupy. The difference between the two last numbers will give the quantity of water in volumes, to be added to the acid expressed by the first of them, in order to correct it and make it of proper strength. On the contrary, if it were found that the 100 parts were insufficient, and that 10 parts more of similar acid were required, then there is too much water by one-eleventh of the whole in bulk, which would be corrected by adding one-tenth of the 35 parts; hence 0.7 parts by weight of the same oil of vitriol that was used before, must be added for every 35 parts of the mixed acid. The correction in any other case may be easily made, by considering that the number of parts over a 100 which are necessary to saturate the 100 grains of carbonate of potash, are proportionate to the quantity of oil of vitriol which must be added to bring the experimental acid to proper strength: thus if 136 parts of the diluted acid were used, then 36-hundredths more of the weight of oil of vitriol already used must be added; and the quantity of oil of vitriol that was added at first being known to be one-fifth by weight, the additional quantity required is easily ascertained.

BLEACHING.

THE art of bleaching is so intimately connected with that of dyeing, which we have lately discussed, that it will be advisable to offer a rather more extended account than we have hitherto been enabled to do on this valuable art. It will best conduce to a right understanding of the subject, if we first give a few observations on the general process in its various degrees of steeping, bucking, washing, &c., and afterwards show the variations which these undergo, when applied to the different materials of cotton, silk, paper, &c.

Steeping.—This process is intended to remove, without the expense of fresh alkaline ley, the im-

purities which the goods may have contracted in passing through the previous stages of manufacture from the spinner and the weaver, and which the subsequent management might tend to fix. Flax is mostly spun by hand, and the spinner constantly moistens it with saliva to make it draw out more readily to the proper grist. Now as saliva is known to be a more universal solvent than even water, we may infer that many impurities may, by this means, be fixed in the yarn. It will also from its nature form, when dry, a pellicle of tenacious matter on the surface of the threads, and may thus prevent the solvents from coming into contact with the coloring matters which are lodged in the body of the thread. Cotton again being spun by jennies and thistle frames is not liable to such regular contamination, but it is sometimes stained by the oil which is used for the machinery. Both are also filled with impurities by the weaver, who finds that he cannot make good work unless he previously dress the yarns with some gelatinous matter that may give it a stronger adhesion. The linen weaver commonly uses for this purpose a sour paste, made from the seeds of oatmeal, which is applied with a brush to the yarn; and then thoroughly dried in by passing a hot iron over the web. He then takes a brush on which he has rubbed a small quantity of tallow, and goes over the whole. The cotton weaver seldom uses the flummery paste, but prefers one made of flour, or of mashed potatoes in a state of fermentation, and sometimes a mixture of both: and the combustibility of the cotton will not permit him to use so expeditious a mode of drying as the hot iron affords. He dries his web with a large fan, and afterwards goes over it with the grease brush in the same way as the linen weaver. The small quantity of grease in the cloth is fixed by the subsequent operation of singeing when this is had recourse to, and if this is not taken out in the previous processes of bleaching, it will not yield afterwards to the usual processes of ashing and souring.

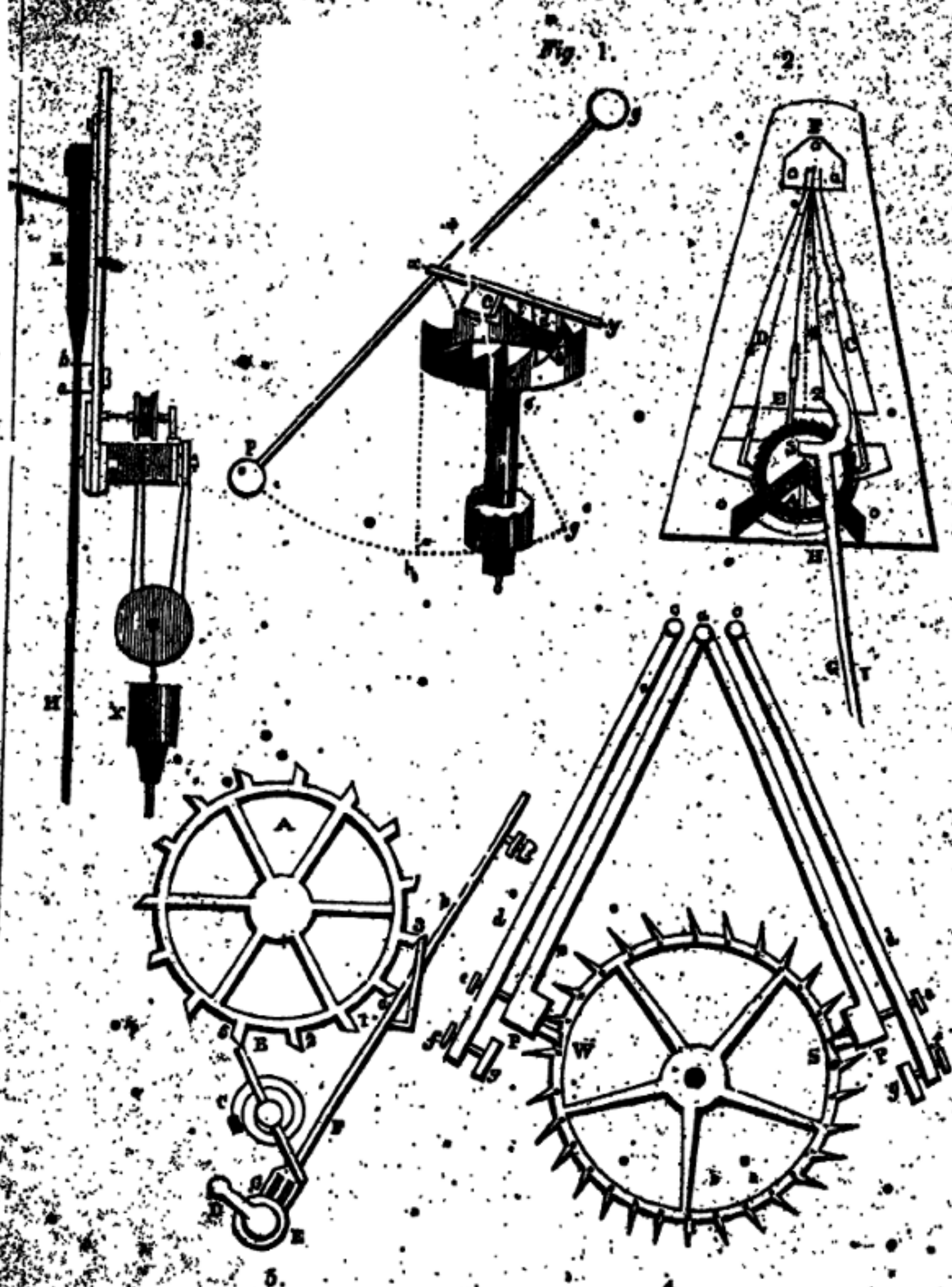
For the removal of these impurities, the first thing to be done is to have the cloth thoroughly washed, (with soap if necessary,) to get rid of what may be loosely attached to it. If time can be spared it would render this washing more effectual to have the goods disposed in very open folds to prevent unequal compression, and soaked in water either in a trough, or in a running stream. They are next placed in similar foldings in a kieve or box which is filled with water or waste alkaline or soap leys at a blood heat, with which they must be sufficiently covered and held down by cross bars; for they soon begin to swell and rise above the surface when this is neglected. Osier twigs must be placed at the bottom to prevent this swelling from causing too much pressure. A smaller degree of heat than that mentioned would not readily dissolve the dressing and a greater might coagulate and fix it in the cloth. In a short time the dressing mixes with the water, and from its previous acidity induces the acetous fermentation. An intestine motion becomes perceptible, the temperature increases, and air bubbles are emitted which by carrying up to the surface some of the light oleaginous particles produce a thick scum. These effects, however, are gentle and slow as the dressing is in small quantity, in proportion to the water. The acid salts, according to Dr. Home, are no sooner separated by the acetous fermentation, from the absorbent earth which made

them not perceptible to the tongue in their former state, than they are united to the oily particles of the tallow which likewise adhere superficially, dissolve them and render them in some degree miscible with water. In this state they are soon washed off by the intestine motion of the liquor. This fermentation continues from twelve to eighteen hours, according to the state of the weather; but even in summer, may be allowed to go on without inconvenience for forty-eight hours. It is known to have continued the proper time when an infinity of white bubbles are seen on the surface, and a fetid smell is perceived; or when the goods have assumed a yellowish color instead of grey or brown. When no more air bubbles rise to support the scum, it separates, is precipitated, and would again become attached to the cloth if it be not timeously removed. But greater danger may be apprehended from the putrid fermentation taking place which would both weaken the texture of the cloth, perhaps rot it, and also generate and fix a dark coloring matter that it might be difficult afterwards to remove. Attention to the indications now given will prevent such serious accidents.

There has been some discussion and difference of opinion respecting the liquid most proper for steeping. Waste alkaline leys are most commonly used, from the idea that they produce the strongest fermentation; but this, if it be the case, may arise from the impurities with which they are loaded. For fine calico bleaching they certainly ought not to be used, as indelible stains may be the consequence. The alkaline salts may attract the acid salts generated by the fermentation, and prevent their combination with the oleaginous impurities. On the contrary, if the alkaline salts are not previously saturated they may be of use in combining with, and carrying off the tallow. Dr. Home tried to come to some decision on this subject, but his experiments proved unsatisfactory. Des Charmes used milk of lime with advantage. He allowed the goods to remain in this liquid not longer than five or six hours, when they were found sufficiently prepared for the subsequent processes. Water however when time can be spared is as efficacious as either this or an infusion of bran which has also been recommended—to this a decided preference is given in Ireland.

When the goods are found to be sufficiently steeped, the steep is to be drawn off and the goods taken to the squeezers, in order that all the loosened impurities may be pressed out. They are then taken to the dash wheel and washed till the water comes off clear, when they are either wrung to such a degree that they may remain only moist, or are left to drain on a proper stage. After rinsing or clearing piece goods, subsequent to steeping, particular attention ought to be paid to rubbing them well with black soap, especially along their selvages, for this part being closer wrought than the rest requires to be particularly cleared to open it to the action of the succeeding detergents. When this is not attended to, it may probably be necessary, after the several operations, to rub them separately by hand, and the bleaching would be retarded by requiring several extraordinary immersions, to prevent these parts from being less perfectly white than the rest. Cottons which have received stains of oil are best cleared by a hot solution of black soap.

(To be continued.)



WATCH ESCAPEMENTS.

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THE motions of a clock or watch are regulated by a pendulum or balance, which serves as a check, without which, the wheels impelled by the weight in the clock, or spring in the watch, would run round with a rapidly accelerating motion, till this should be rendered uniform by friction, and the resistance of the air; if, however, a pendulum or balance be put in the way of this motion, in such manner that only one tooth of a wheel can pass, the revolutions of the wheel will depend on the vibration of the pendulum or balance.

We know that the motion of a pendulum or balance is alternate, while the pressure of the wheels is constantly exerted in the same direction. Hence, it is evident that some means must be employed to accommodate these different motions to each other. Now, when a tooth of the wheel has given the pendulum or balance a motion in one direction, it must quit it, that the pendulum or balance may receive an impulsion in the opposite direction. This *escaping* of the tooth has given rise to the term *escapement*.

The ordinary escapement is extremely simple, and may be thus illustrated. Let XY , Fig. 1, represent a horizontal axis, to which the pendulum is attached by a slender rod. This axis has two leaves, C and D , one near each end, and not in the same plane, but so that when the pendulum hangs perpendicularly at rest, C spreads a few degrees to the right, and D as much to the left. These are called the pallets. Let AEB represent a wheel, turning on a perpendicular axis, EO , in the order AEB . The teeth of this wheel are in the form of those of a saw, leaning forward in the direction of the rim's motion. This wheel is usually called the *crown-wheel*, or in watches the *balance-wheel*. It contains an odd number of teeth. In the figure the pendulum is represented at the extremity of its excursion towards the left, the tooth A having just escaped from the pallet C , and B having just dropped on D .

Now it is evident, that while the pendulum is moving to the left, in the arc PG , the tooth B still presses on the pallet D , and thus accelerates the pendulum, both in its descent along PH , and its ascent up IG , and that when D , by turning round the axis XY , raises its point above the plane of the wheel, the tooth B escapes from it, and I drops on C , now nearly perpendicular. Thus C is pressed to the right, and the motion of the pendulum along GP is accelerated. Again, while the pendulum hangs perpendicularly in the line XH , the tooth B , by pressing on D , will force the pendulum to the left, in proportion to its lightness, and if it be not too heavy, will force it so far from the perpendicular that B will escape, and I will catch on C , and force the pendulum back to P , when the same motion will be repeated. This effect will be the more remarkable if the rod of the pendulum be continued through XY , and have a ball Q , on the other end, to balance.

When B escapes from D , the balls are moving with a certain velocity and momentum, and in this condition the balance is checked when I catches on C . It is not, however, instantly stopped, but continues to move a little to the left, and I is forced a little backward by the pallet C . It cannot make its escape over the top of the tooth I , as all the momentum of the balance was generated by the

force of B , and I is of equal power. Besides, when I catches on C , and the motion of C , to the left, continues, the lower point of C is applied to the face of I , which now acts on the balance by a long lever, and soon stops its motion in that direction, and, continuing to press on C , urges the balance in the opposite direction. In this, it is evident that the motion of the wheel is hobbling and unequal, by which this escapement has received the appellation of the *recoiling escapement*.

In considering the utility of the following improved escapement for clocks, we must keep in mind the following proposition, which, after the above illustration, scarcely requires any proof. It is, that the natural vibrations of a pendulum are *isochronous*, or are performed in equal times. The great object of the escapement is to preserve this isochronous motion of the pendulum.

In 1812, Mr. Prior, Jun. was rewarded by the Society of Arts for the construction of a remontoire escape which possesses considerable merit. The swing-wheel A , Figs. 2 and 3, has thirty teeth cut in its periphery, and is constantly urged forward by the maintaining power, which is supplied by a small weight X , Fig. 3; CD are two spring detents catching the teeth of the wheel alternately, these are, at the proper intervals, unlocked by the parts marked 2 and 3, Fig. 2, upon the pendulum rod H , intercepting small pins A and B , Fig. 3, projecting from the detents, as it vibrates towards the one or the other; E is the renovating or remontoire spring, fixed to the same stud F , as the detents; it is wound up by the highest tooth of the wheel, as seen in Fig. 2, (its position when unwound being shown by the dotted line.) This being the case, suppose a tooth of the wheel is caught by the detent D , which prevents the wheel from moving any further, and keeps the renovating spring from escaping off the point of the tooth; in this position, the pendulum is quite detached from the wheel; now, if the pendulum be caused to vibrate towards G , the part of it marked 2 comes against the pin B , Fig. 3, projecting from the renovating spring E , and pushes this spring from the point of the wheel's tooth; on vibrating a little further, it removes the detent D , which detained the wheel, by the part 3 striking the pin A , which projects from the detent; the maintaining power of the clock causes the wheel, thus unlocked, to advance until detained by a tooth resting upon the end of the detent C , on the opposite side; by this means the renovating spring will be clear of the tooth of the wheel as it returns with the pendulum, and gives it an impulse, by its pin B pressing against the part 2 of the pendulum, until the spring comes to the position shown by the dotted line, in which position it is unwound, and rests against a pin fixed in the cross bar of the plate; the pendulum continues vibrating towards I , nearly to the extent of its vibration, when the part 1 meets the pin in the detent C , and removes it from the wheel, and unlocks it; the maintaining power now carries it forward, pushing the renovating spring E before it, until another tooth is caught by the detent D , which detains the wheel in the position first described, the renovating spring being wound up ready to give another impulse to the pendulum.

The following description of a clock escapement, contrived by Mr. Reid some years ago, is extracted from the "Edinburgh Encyclopedia." Fig. 4, SW is the swing-wheel, whose diameter may be so large as to be sufficiently free of the arbor of the wheel that runs into its pinion,

which in eight-day clocks is the third. The teeth of this swing-wheel are cut thus deep, in order that the wheel may be as light as possible, and the strength of the teeth little more than what is necessary to resist the action or force of a common clock weight through the wheels. They are what may be called the locking-teeth, as will be more readily seen from the use of them afterwards to be explained. Those called the impulse-teeth, consist of very small tempered steel pins, inserted on the surface of the rim of the wheel on one side only. They are nearly two-tenths of an inch in height; and the smaller they are so much more room will be given for the thickness of the pallets. P P are the pallets whose centre of motion is the same as that at the verge at A. These pallets are formed so as to have the arms sufficiently strong, and at the same time as light as may be. That part where the arms meet at the angle at A, has a steel socket made out of the same piece as the arms, being forged together in this manner. The socket is made to fit well on the verge, on which it is only twisted fast, and is turned pretty smooth on the outside, in order to allow the arbors of the detents to be laid as close to the verge as may be, so that their centres of motion may coincide as nearly as possible. D D are the detents whose centre of motion is at C C. They are fixed on their arbors by a thin steel socket, made and forged with the detents, much in the same way as the pallets were. The screws E E, serve for the purpose of adjusting that part of the escapement connected with the pallets pushing the detents out from locking the wheel, by means of locking the teeth. The ends of the screws E E, on the unlocking, are met by the ends of the pallets. The screws F F seem to adjust the locking of the wheel-teeth on the detents; G G are brass rectangular pieces, or studs, which are fixed to the inside of the pillar frame plate, and may be near an inch high. The ends of the screws F F rest on the side of these studs, and according as they are more or less screwed through at the ends of the detents, so much less or more hold will the detent piece have of the teeth. These holding pieces of the detents are not represented in the engraving, as they would have made other parts of it rather obscure. They are made of stone, and are fitted in by means of a dovetail in a piece left for that purpose, on the inside of the detent-arms.

On the left-hand side the pin tooth is represented as having just escaped its pallet; but previous to its having got on to the flanch of this pallet, let us conceive that the back of the pallet, had come, in consequence of the motion of the pendulum, to that side, and opposing the screw E, which is in the detent arm, pushes or carries it on with it, and consequently unlocks the tooth of the wheel, which then endeavours to get forward, but the pin tooth at this instant of unlocking, meeting with the flanch of the pallet at the lower edge inside, and pushing forward on the flanch, by this means impels the pendulum, and after having escaped the pallet, the next locking tooth is received by the detent, on the right-hand side, where the wheel is now again locked. In the mean time, while the pendulum is describing that part of its vibration towards the left hand free and detached, as the pallets are now at liberty to move freely and independently of the small pin teeth, on the return of the pendulum to the right-hand side, the detent, by means of the pallet on the left, is pushed out from locking the wheel, and at the instant of unlocking, the wheel gets forward, and the pin tooth is at the same instant ready

to get on the flanch of its pallet, and gives new impulse to the pendulum, as is obvious by what is represented in Fig. 4. After the pin tooth has escaped the pallet, the wheel is again locked on the opposite or left-hand side; the pendulum moves on to the right freely and independently till the next locking on the left takes place, and so on. It may be observed, that the unlocking takes place when the pendulum is near the lowest point, or point of rest and of course where its force is nearly a maximum.

Another escapement, in which a considerable degree of ingenuity is united with comparative simplicity, is that of Mr. De Lafons. The inventor's description, as presented to the Society of Arts, is as follows:—A, Fig. 4, shows the scape-wheel; B, the lever-pallet, or an arbor with fine pivots, having at the lower end, C, the remontoire or spiral spring fixed with a collar and stud, as pendulum-springs are; D, the pallet of the verge, having a roller turning in small pivots for the lever-pallet to act against; E, pallets to discharge the locking, with a roller between. F, the arm of the locking-pallet continued at the other end to make it poise, having studs and screws to adjust and bank the quantity of motion. A and B, the locking-pallets, being portions of circles, fastened on an arbor turning on fine pivots G, the triple fork, at the end of the arm of the locking-pallets. The centre of the lever-pallet in the draft is in a right line between the centre of the scape-wheel and the centre of the verge, though in the model it is not: but may be so or not, as best suits the caliper, &c. The scape-wheel A, with this tooth 1, is acting on the lever-pallet B, and has wound up the spring C; the verge pallet D the moment it comes within the reach of the lever-pallet, the discharging pallet E taking hold of one prong of the fork, removes the arm F, and relieves the tooth 3 from the convex part of the lock A. The wheel goes forward a little, just sufficient to permit the lever-pallet to pass, while the other end gives the impulse to the balance; the tooth 4 of the wheel is then locked on the concave side of the lock B, and the lever-pallet is stopped against the tooth 5. So far the operation of giving the impulse, in order again to wind the remontoire-spring, (the other pallet at E, in the return, removing the arm F the contrary direction,) relieves the tooth 3 from the lock B. The wheel again goes forward, almost the whole space, from tooth to tooth, winds the spiral spring again, and comes into the same situation as at first, and thus the whole performance is completed. The end of the lower pallet B resting on the point of the tooth 1, prevents the wheel exerting its full force on the lock A, as in Fig. 5. This escapement may be much simplified by putting a spring with a pallet made in it, instead of the lever-pallet and spiral spring. The operation will be in other respects exactly the same, avoiding the friction of the pivots of the lever-pallet. The locking may be on any two teeth of the wheel, as may be found most convenient.

CURIOUS PHENOMENA OF SOUND.

ALTHOUGH, among the phenomena of the material world, there is scarcely one which, when well considered, is not an object of wonder, yet those which we have been accustomed to witness from our infancy lose all their interest from the frequency of their occurrence, while to the natives of other countries they are unceasing objects of astonish-

ment and delight. The inhabitant of a tropical climate is confounded at the sight of falling snow, and he almost discredits the evidence of his senses when he sees a frozen river carrying loaded waggons on its surface. The diffusion of knowledge by books, as well as by frequent communication between the natives of different quarters of the globe, has deprived this class of local wonders of their influence, and the Indian and the Scandinavian can visit each other's lands without any violent excitement of surprise. Still, however, there are phenomena of rare occurrence, of which no description can convey the idea, and which continue to be as deeply marked with the marvellous as if they had been previously unknown. Among these we may rank the remarkable modifications which sound undergoes in particular situations and under particular circumstances.

In the ordinary intercourse of life, we recognize individuals as much by their voice as by the features of their face and the form of the body. A friend who has been long absent will often stand before us as a stranger, till his voice supplies us with the full power of recognition. The brand imprinted by time on his outer form may have effaced the youthful image which the memory had cherished, but the original character of his voice and its yet remembered tones will remain unimpaired.

The permanence of character thus impressed upon speech exists only in those regions to whose atmosphere our vocal organs are adapted. If either the speaker or the hearer is placed in air differing greatly in density from that to which they are accustomed, the voice of the one will emit different sounds, or the same sounds will produce a different impression on the ear of the other. But if both parties are placed in this new atmosphere, their tones of communication will suffer the most remarkable change. The two extreme positions, where such effects become sufficiently striking, are in the compressed air of the diving-bell, when it is immersed to a great depth in the sea, or in the rarefied atmosphere which prevails on the summit of the Himalaya or the Andes.

In the region of common life, and even at the stillest hour of night, the ear seldom rests from its toil's. When the voice of man and the bustle of his labours have ceased, the sounds of insect life are redoubled; the night breeze awakens among the rustling leaves, and the swell of the distant ocean, and the sounds of the falling cataract or of the murmuring brook, fill the air with their pure and solemn music. The sublimity of deep silence is not to be found even in the steppes of the Volga, or in the forests of the Orinoco. It can be felt only in those lofty regions

Where the tops of the Andes
Shout soaringly & rth."

As the traveller rises above the limit of life and motion, and enters the regions of habitual solitude, the death-like silence which prevails around him is rendered still more striking by the diminished density of the air which he breathes. The voice of his fellow-traveller ceases to be heard even at a moderate distance, and sounds which would stun the ear at a lower level make but a feeble impression. The report of a pistol on the top of Mont Blanc is no louder than that of an Indian cracker. But while the thinness of the air thus subdues the loudest sounds, the voice itself undergoes a singular change: the muscular energy by which we speak experiences a great diminution, and our powers of utterance, as well as our power of hearing, are thus singularly

modified. Were the magician, therefore, who is desirous to impress upon his victim or upon his pupil the conviction of his supernatural power, to carry him, under the injunction of silence,

- to breathe
The difficult air of the red mountain's top
Where the birds dare not build, nor insect's wing
Flit o'er the herbless granite."

he would experience little difficulty in asserting his power over the elements, and still less in subsequently communicating the same influence to his companion.

But though the air at the tops of our highest mountains is scarcely capable of transmitting sounds of ordinary intensity, yet sounds of extraordinary power force their way through its most attenuated strata. At elevations where the air is three thousand times more rare than that which we breathe, the explosion of meteors is heard like the sound of cannon on the surface of the earth, and the whole air is often violently agitated by the sound. This fact alone may give us some idea of the tremendous nature of the forces which such explosions create, and it is fortunate for our species that they are confined to the upper regions of the atmosphere. If the same explosions were to take place in the dense air which rests upon the earth, our habitations and our lives would be exposed to the most imminent peril.

Buildings have often been thrown down by violent concussions of the air, occasioned either by the sound of great guns, or by loud thunder, and the most serious effects upon human and animal life have been produced by the same cause. Most persons have experienced the stunning pain produced in the ear, when placed near a cannon that is discharged. Deafness has frequently been the result of such sudden concussions, and if we may reason from analogy, death itself must often have been the consequence. When peace was proclaimed in London in 1697, two troops of horses were dismounted and drawn up in line in order to fire their volleys. Opposite the centre of the line was the door of a butcher's shop, where there was a large mastiff dog of great courage. This dog was sleeping by the fire, but when the first volley was fired, it immediately started up, ran into another room, and hid itself under a bed. On the firing of the second volley, the dog rose, ran several times about the room trembling violently, and apparently in great agony. When the third volley was fired, the dog ran about once or twice with great violence and instantly fell down dead, throwing up blood from his mouth and nose.

Sounds of known character and intensity are often singularly changed even at the surface of the earth, according to the state of the ground and the conditions of the clouds. On the extended heath, where there are no solid objects capable of reflecting or modifying sound, the sportsman must frequently have noticed the unaccountable variety of sounds which are produced by the report of his fowling-piece. Sometimes they are flat and prolonged, at other times short and sharp, and sometimes the noise is so strange that it is referred to some mistake in the loading of the gun. These variations, however, arise entirely from the state of the air, and from the nature and proximity of the superjacent clouds. In pure air of uniform density the sound is sharp and soon over, as the undulations of the air advance without any interrupting obstacles. In a foggy atmosphere, or where

the vapours produced by heat are seen dancing as if were in the air, the sound is dull and prolonged; and when these clouds are immediately overhead, a succession of echoes from them produces a continued or reverberating sound. When the French astronomers were determining the velocity of sound, by firing great guns, they observed that the report was always single and sharp under a perfectly clear sky, but indistinct, and attended by a long-continued roll like thunder, when a cloud covered a considerable part of the horizon. It is no doubt owing to the same cause, namely, the reflection from the clouds, that the thunder rolls through the regions, as if it were produced by a succession of electric explosions.

The great audibility of sounds during the night is a phenomenon of considerable interest, and one which had been observed even by the ancients. In crowded cities or in their vicinity, the effect was generally ascribed to the rest of animated beings, while in localities where such an explanation was inapplicable, it was supposed to arise from a favorable direction of the prevailing wind. Baron Humboldt was particularly struck with this phenomenon when he first heard the rushing of the great cataracts of the Orinoco in the plain which surrounds the Mission of the Apures. These sounds he regarded as three times louder during the night than during the day. Some authors ascribed this fact to the cessation of the humming of insects, the singing of birds, and the action of the wind on the leaves of the trees, but M. Humboldt justly maintains that this cannot be the cause of it on the Orinoco, where the buzz of insects is much louder in the night than in the day, and where the breeze never rises till after sunset. Hence he was led to ascribe the phenomenon to the perfect transparency and uniform density of the air, which can exist only at night after the heat of the ground has been uniformly diffused through the atmosphere. When the rays of the sun have been beating on the ground during the day, currents of hot air of different temperatures, and consequently of different densities, are constantly ascending from the ground and mixing with the cold air above. The air thus ceases to be a homogeneous medium, and every person must have observed the effects of it upon objects seen through it which are very indistinctly visible, and have a tremulous motion, as if they were "dancing in the air." The very same effect is perceived when we look at objects through spirits and water that are not perfectly mixed, or when we view distant objects over a red-hot poker or over a flame. In all these cases the light suffers refraction in passing from a medium of one density into a medium of a different density, and the refracted rays are constantly changing their direction as the different currents rise in succession. Analogous effects are produced when sound passes through a mixed medium, whether it consists of two different mediums or of one medium where portions of it have different densities. As sound moves with different velocities through media of different densities, the wave which produces the sound will be partly reflected in passing from one medium to the other, and the direction of the transmission wave changed; and hence in passing through such media different portions of the wave will reach the ear at different times, and thus destroy the sharpness and distinctness of the sound. This may be proved by many striking facts. If we put a bell in a receiver containing a mixture of hydrogen gas

and atmospheric air, the sound of the bell can scarcely be heard. During a shower of rain or of snow, noises are greatly deadened; and when sound is transmitted along an iron wire or an iron pipe of sufficient length, we actually hear two sounds, one transmitted more rapidly through the solid, and the other more slowly through the air. The same property is well illustrated by an elegant and easily repeated experiment of Chladni's. When sparkling champagne is poured into a tall glass till it is half full, the glass loses its power of ringing by a stroke upon its edge, and emits only a disagreeable and puffy sound. This effect will continue while the wine is filled with bubbles of air, or as long as the effervescence lasts; but when the effervescence begins to subside, the sound becomes clearer and clearer, and the glass rings as usual when the air-bubbles have vanished. If we reproduce the effervescence by stirring the champagne with a piece of bread, the glass will again cease to ring. The same experiment will succeed with other effervescing fluids.

DOMESTIC WINE-MAKING.

EVERY cookery-book and receipt-book is full of processes for making a multiplicity of domestic wines. These never take into account that an unvarying process cannot be adapted to the ever-changing nature of our fruits, the qualities of which are different, according as the season has been wet or dry, cold or warm; according as the soil was exhausted or well manured; according as the trees were skilfully or ignorantly pruned, and several other circumstances not necessary here to enumerate. These popular processes, therefore, almost never succeed: hence our domestic wines have a bad character; and hence the art of making them is but little cultivated. In almost no instance, so far as domestic economy is concerned, can the principles of chemistry be applied with better effect than to the preparation of our native wines. And in a national point of view it is to be lamented that no sufficient encouragement has been given to the art, either by the legislature or by the various learned societies which, in other respects, have so materially contributed to the progress of knowledge.

Wine from ripe Gooseberries.—Ten gallons of gooseberries are to be bruised in a tub, and left so for twenty-four hours. The pulp thus prepared is to be introduced, either at once, or in successive portions, into a hair-cloth or canvass bag, and submitted to pressure. The matter remaining in the bag is to be returned into the tub, and five gallons of tolerably hot water are to be poured on; the whole is to be well mixed up. After thus remaining in the tub well covered for about twelve hours, the matter is to be pressed through the bag, and the liquor obtained is to be mixed with the original juice. The solid matter of the fruit is then worth very little, and may be thrown away.

In every five gallons of the liquor, consisting of the mixture of the original juice with the infusion, twelve pounds of white sugar are to be dissolved perfectly.

If the liquor be now left to itself, it will, after some hours, show symptoms of a commencing fermentation. In proportion as the fruit is ripe, the temperature of the weather ought to be high. Should it be very cool weather, the liquor should be placed near the fire. If the gooseberries were

unripe, or just ripening, the fermentation will take place at a lower temperature, and with more activity. The progress of the fermentation should be frequently ascertained by tasting the liquid, it becoming continually less sweet until at length the sweetness totally disappears: at this period the fermentation is complete. When the fruit has been over-ripe, or when the weather is remarkably cool, the last portions of sugar remain a long time unaltered, and the fermentation is suspended. Placing the containing vessel near the fire will always renew the fermentation: so long as this degree of heat is kept up the fermentation will proceed. When the quantity of wine under fermentation is very considerable, it will generally keep up its own temperature.

Should the season be so warm, and the fermentation so rapid, as to excite fears of souring, which, however, will seldom happen while the quantity is so small as ten or twenty gallons in each fermenting tub, we can readily avert the danger by racking off from the lees, having first skimmed off the head of yeast. When the fermentation has totally ceased, the wine is to be racked off as clear as it can be procured. To every five gallons of it two quarts of brandy, or good old malt spirit, are to be added, well mixed, and left to settle; for the spirit causes a separation of flocks which previously had been in solution. After subsidence for perhaps a month, the clear liquor is to be cautiously drawn off, introduced into a cask which it just fills, and set by in a cool cellar for a great length of time. It is seldom that the impatience and curiosity of inexperienced makers of domestic wines for family use can brook the delay of keeping the wine long enough to mellow sufficiently. The wine just described will require five years at least to be in its best condition, and must have been kept in wood all that time; it may then be bottled. A much shorter time will, however, render it tolerable.

Red Currant Wine.—Bruise perfectly three gallons of red currants, ripe, and picked from the stalks. Press out the juice. Infuse the residual cake of fruit in four and a half gallons of cold water for twenty-four hours; frequently mixing, so as to obtain equal diffusion. Press out the liquor; mix it with the juice; add fourteen pounds of loaf-sugar. Dissolve; transfer the whole into a cask which the liquor does not entirely fill; put in a bung with a gimlet-hole through it; and keep it in the temperature of 70° for a month. In that time the fermentation will have greatly abated. Add three pounds of sugar, dissolved in two quarts of warm water; shake the cask well, and put in the same bung. The fermentation will go on for another month, or perhaps two. When it has totally ceased, which will be known by disteping at the bung-hole, the clear liquor is to be racked from the sediment, by a cock or syphon; mix with two quarts of best French brandy, and set by in a cellar for two months. The liquor is to be again racked off clear, transferred into a clean (not new) cask which it fills, bunged down air-tight, and left in a cool cellar for at least three years, but five years will be much better. There will be six gallons. During the whole fermentation, the temperature of 70° must be maintained; keeping the cask beside the fire when necessary.

White Currant Wine.—May be made according to the same formula, from white currants. Two pounds of bitter almonds, bruised, may be mixed in the fermenting liquor.

Black Currant Wine.—Is to be made according to the same formula, from two gallons of black currants, strawberries one gallon.

Strawberry or Raspberry Wine.—Bruise three gallons of either fruit, press out the juice, and on the marc pour three gallons of water; infuse, press out as before, and add the liquor to the juice. Then add two gallons of cider, eight pounds of sugar, the rind of a lemon cut thin, and an ounce of powdered red tartar. Ferment as before, and at the proper time add one gallon of brandy. For raspberry wine, a gallon of juice of red and white currants ought to be substituted for a gallon of the water above directed.

Elderberry Wine.—To be made from elderberries, four gallons; water, seventeen quarts; sugar, eighteen and a half pounds; red tartar, three ounces; sliced ginger, one ounce and a half; bitter almonds bruised, one ounce and a quarter. Ferment as before; and, at the proper time, add three pints of brandy.

Damson or Cherry Wine.—Eight gallons of the fruit, with about one eighth of the stones broken, water eleven gallons, sugar thirty pounds, red tartar six ounces, brandy one gallon. Press out the juice, and infuse the water for twenty-four hours on the marc, so as to obtain flavor from the stones. Then proceed as in other cases.

Mead or Metheglin (white).—The juice expressed from two gallons of white currants, boiling water fifteen and a half gallons, honey thirty pounds, tartar three ounces. These are to be well mixed by constant stirring for a quarter of an hour, and then allowed to ferment. When the fermentation is complete, and the liquor clear, one gallon of brandy is to be added, and it is to be immediately bottled. In a few months it will be fit for drinking, and will sparkle in the glass. Some, however, prefer having it as a still wine, and use it as a summer draught mixed with water.

Red Mead.—May be made by using six quarts of red currants, and two of black, instead of the foregoing two gallons of white currants, along with a pound of beet root cut into the thinnest slices. Some persons make mead on the large scale, for sale, of mere honey and water, without fruit; but the article which is thus produced, is flavorless and heavy, and is by no means in general request.

Cider White Wine.—A mixture of apple juice sixteen gallons, honey sixteen pounds, white tartar four ounces, cinnamon broken, cloves, and mace, of each one ounce. Inclose the aromatics loosely in coarse canvass; and suspend them in the liquor while it ferments. The fermentation being over, add one gallon of rum.

Ginger Beer.—Is made as follows:—Take two ounces and a half of the best ginger, reduced to a coarse powder. Pour on it four gallons of boiling water, and let them stand until cold. The liquor is then to be strained through a sieve or flannel. In this are to be dissolved four pounds of loaf-sugar; and half a pint of solid yeast is to be added, along with two ounces of cream of tartar. If the weather be not sufficiently warm, the cask containing this mixture is to be set near the fire, so as to excite a brisk fermentation. As soon as this subsides, the liquor is to be racked off clear, the cask washed out, the liquor returned, and allowed to work a day or two longer. It is then to be drawn off, without agitation, into strong bottles or casks, which, when well corked, are to be moved down.

This beverage, if in good order, froths high in the glass when poured out, and retains its carbonic acid for a length of time. Ginger has this remarkable property of occasioning a high, close, creamy head upon all effervescing liquors. An extemporaneous and pleasant imitation of ginger beer is generally made by dissolving thirty grains of tartaric acid with a quarter of an ounce of white sugar in half a pint of water. With this solution are to be mixed six or ten grains of finely powdered ginger, and afterwards twenty-four grains of bicarbonate of soda in finest powder. The whole is instantly to be well mixed up, and drunk while effervescing.

Wine from Vine-leaves.—Not only does the fruit of the vine afford wine, but even its leaves, young shoots, and tendrils, are capable of being converted to this use. Dr. Macculloch says, "chemical examination has proved that the young shoots, the tendrils, and the leaves of the vine, possess properties and contain substances exactly similar to the crude fruit. It was no unnatural conclusion that they might equally be used for the purposes of making wine. Experiments were accordingly instituted in France for this purpose, and they have been repeated here with success. From vine-leaves, water, and sugar, wines have been thus produced in no respect differing from the produce of the immature fruit, and consequently resembling wines of foreign growth." The leaves of the claret vine produce wine of a delicate red color. The leaves may be taken at any period from vines which have been cultivated for this purpose, and from which no fruit is expected. The leaves are best when young, and must be plucked with their stems. Forty or fifty pounds of such leaves being introduced into a tub of sufficient capacity, seven or eight gallons of boiling water are to be poured on them, in which they are to infuse for twenty-four hours. The liquor being poured off, the leaves must be pressed in a press of considerable power; and being subsequently washed with an additional gallon of water, they are again to be pressed. The sugar, varying from twenty-five to thirty pounds, is then to be added to the mixed liquors; and the quantity being made up to ten gallons and a half, the process recommended in the case of gooseberries is to be followed.

Raisin Wine.—Take twenty-eight pounds of raisins picked from the stalks. Let them be chopped into small bits with any proper instrument, and thrown into a deep tub or bucket. Pour on them three gallons of tolerably hot water, and let them stand for twelve hours. Throw the whole into a hair-cloth or canvass bag, and with a press of sufficient power force out the juice. On the mare pour two gallons more of hot water, and after twelve hours press out as before. Mix the two liquors; add three pounds of white sugar, and dissolve it perfectly. A fermentation will set in; when over, the liquor is to be racked into a clean cask, and bunged up for three months, after which it is to be again racked. A quarter of an ounce of isinglass dissolved in a little water or wine is to be mixed with it, and the whole returned into the cask. Being closely bunged, it is to remain for twelve months, after which it may be bottled. The cask should be full.

Wine from unripe Grapes.—As no bad flavor is communicated by the husk or stem of the grape, this fruit may be used in any stage of immaturity in which it is most conveniently obtained. Grapes of different degrees of maturity may even be mixed together, and it is requisite to attend to the

selection of any particular variety. If fruit raised out of doors is to be used, it will be preferable to wait till the grapes show a tendency to ripen, or till the advance of the cold season shows that no farther change can be expected. The proportions and treatment are precisely similar to those laid down for the gooseberry.

BLEACHING.

(Continued from page 138.)

Bucking.—This is one of the processes which has lately received important improvements from the invention of an apparatus called the whale boiler. But whether this be used, (and it is not yet general,) or the old apparatus, the goods are treated precisely in the same way, and it is a very important part of the whole operations. The first thing to be attended to in bucking is the preparation of an alkaline ley of a proper strength. For this purpose the crude alkali is to be broken into small pieces not exceeding the bigness of a hazel nut, or bruised by means of a horse mill, and put into the boiler with a proper quantity of water. It would be an economizing of fuel to put this into the boiler immediately on drawing off old leys, when the heat of the boiler and its fire place, supposing a small quantity of the fire to remain, the registers of the furnace being shut up and the boiler covered, will be sufficient to melt the alkali in the course of the night. If pearlashes are added to a ley made from the other crude alkalies, they need not be put in till the solution is nearly completed, as their greater quantity of carbonic acid renders them much easier to dissolve. Those who pursue the older modes of bleaching, put the goods into the alkaline solution which is thus prepared; but as its strength can be, according to Kirwan's experiments, increased one half by the addition of so cheap an article as quick-lime, this ought never to be neglected, particularly also as chemistry informs us, that no alkali will combine with any oleaginous matter (unless it be in a state of causticity). It is of great importance to attend to this when American pearlash is used, as it always contains a large proportion of carbonic acid. Des Charmes advises to take of quick-lime the whitest which can be had, a third or a fourth part in weight of the solution, and beat up in a bag or cloth to prevent it from rendering the ley turbid. A better method is to add one part of well-burned fresh-slaked and finely pulverised quick-lime, to two parts of the alkali dissolved as above. When the lime has been added, the mixture is to be brought to boil, taking care to keep it in constant agitation with an iron rake, to prevent the lime from subsiding and fixing on the bottom of the boiler. When the ebullition has commenced, it will produce sufficient agitation to keep the lime suspended. The boiling may be continued for two hours, when the lime may be allowed to subside and the clear supernatant liquor now in a state of causticity from the loss of its carbonic acid may be run off for use. The lime which has subsided is to be washed with water till it comes off clear without alkaline taste, and the washings are to be kept for making fresh leys. The bleachers ignorant of chemistry erroneously imagine that the lime imparts some of its properties to the ley, but as the precipitated lime is found to be a carbonate, it clearly appears that it has by superior affinity abstracted the acid from the carbonated alkali.

When leys are made caustic by means of quick-lime, and drawn off for use, they will commonly be of the same strength at the top and bottom of the vessel. But when they are not removed from the boiler, but the goods put in as soon as the solution has been effected, the liquor will be often three-fourths stronger at the bottom than at the top, from the undissolved alkali continuing to melt. This ought to be carefully attended to, as it is contrary to the general law which obtains in solutions namely, that they are of equal strength throughout. It is of importance that the ley should be always as clear and limpid as possible, for if the lime remain either in solution or suspension in the smallest proportion, it is apt to be precipitated into the fabric of the cloth, and will be fixed by the sulphuric acid sour which will produce an insoluble sulphate. This, however, is not of so much consequence for the two or three first immersions, as it is when the goods have once acquired an even color, and require only to be brightened. It is then essential for the saving of time and labor, to have them as colorless as possible.

The goods which have been treated as already directed, are placed in the kieve in open folds, as in the steeping process, and a quantity of the caustic ley is poured over them, sufficient for their thorough immersion, (heated to the temperature of the blood). The heat is increased very gradually till it reach the boiling point, when it is thrown up and spread over the surface of the goods, through which it percolates into the boiler again, and so on in succession till it be saturated with impurities. This is known from its losing its causticity and acquiring an offensive smell, or from the deepness of the color both of the ley and the cloth. The success of the process indeed is commonly estimated in proportion to the deepness of the color which the cloth has acquired. Particular attention ought to be given to the gradual increase of temperature now directed. For the resinous or oleaginous coloring matter of the cloth, the twisting of the threads, and closeness of texture, must hinder the liquid from penetrating it, particularly, at first, so that if the ley were poured on at 212° the cloth might be liable in several parts to a dry heat. This is usually illustrated by the general effects which heat produces on colored vegetable. Thus—if any vegetable is to be softened, or to have its juices extracted, it is found that this can best be done by beginning with moderate degrees of heat, than by plunging it all at once in boiling water, which would rather harden it and fix its colors. Cooks are well aware of this, and always when they wish to preserve the green color of vegetables after boiling, never put them in till the water has acquired its highest temperature. The same reasoning applies to the process of bucking; and here also it is confirmed by experience, as goods which have unfortunately been put into boiling ley at the first instance, can never be brought to a good white.

Des Charmes's method excluded boiling as unnecessary, it being sufficient, he thinks, that the ley be hot and sufficiently abundant. He takes out his goods when the ley is under the cover in the middle of the heap, so as not to admit of the hand being held in it, or when it simmers round the circumference of the boiler, and throws up white bubbles, which circulate towards the centre. Frequently he only plunged the goods for a few minutes into ley of a very gentle heat, and he found that by

this treatment both cotton and piece goods bleached perfectly well.

The leys, when the above circumstances are indicated, are to be drawn off, and warm water poured over the cloth in the kieve which, by combining with part of the remaining impurities which have been loosened, serves to carry them off. When this has been done, a stream of cold water is allowed to play on the goods, till it run off nearly limpid, after which they are taken to the dash wheel; the reason for this process, which is not always properly attended to, is, that were the cloth carried from the kieve to the dash wheel while hot, a certain portion of the coloring matter would be again fixed in it, which would not easily be again removed.

The process of bucking is successively repeated even as often as eight or ten times before the operations are finished, and with leys of different strength. The practice of our bleachers in Scotland and Ireland is to use the weakest leys at the commencement, and increase them in strength as they proceed. Dr. Home's reasoning on this seems to be conclusive. "The leys," he says, "should be weakest in the first buckings, because then they act only on the more external parts, but when the cloth is more opened, and the field of action increased, the chemical agent ought likewise to be invigorated."

In repeating the bucking process most bleachers occasionally use leys which have formerly been used for a similar purpose even more than once. This practice we have already reprobated when treating of steeping, and in the present case it is of no less importance to avoid it, particularly in bucking fine goods: They seem to have been led to this bad practice from its apparent economy, but when it is considered that it is only the unsaturated portion which can act, pure ley must evidently be cheaper. Besides, cloth bucked with foul ley, becomes heavier instead of lighter, and consequently must receive impurity from it.

(To be continued.)

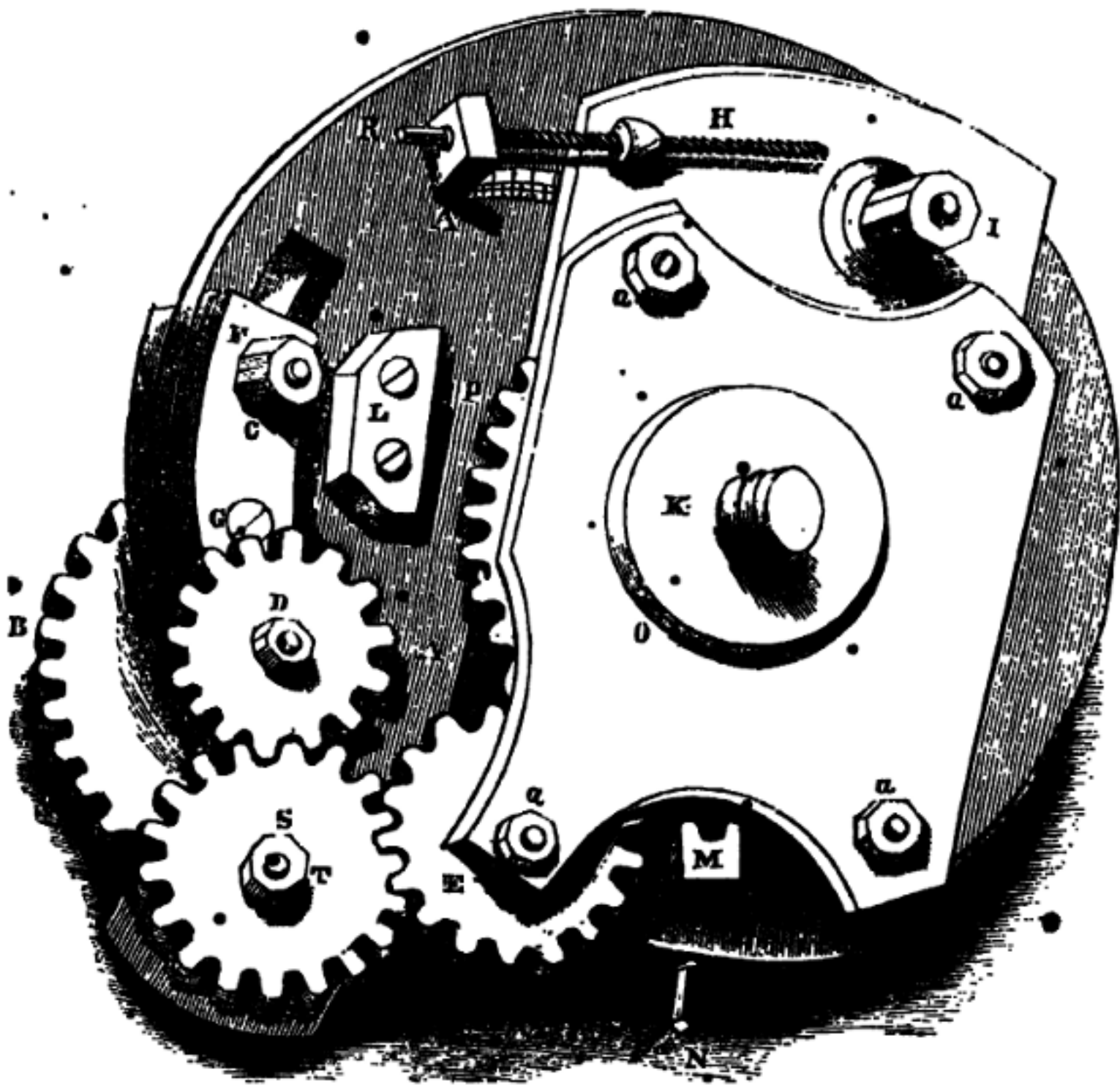
COMPOSITION ORNAMENTS.

(To the Editor.)

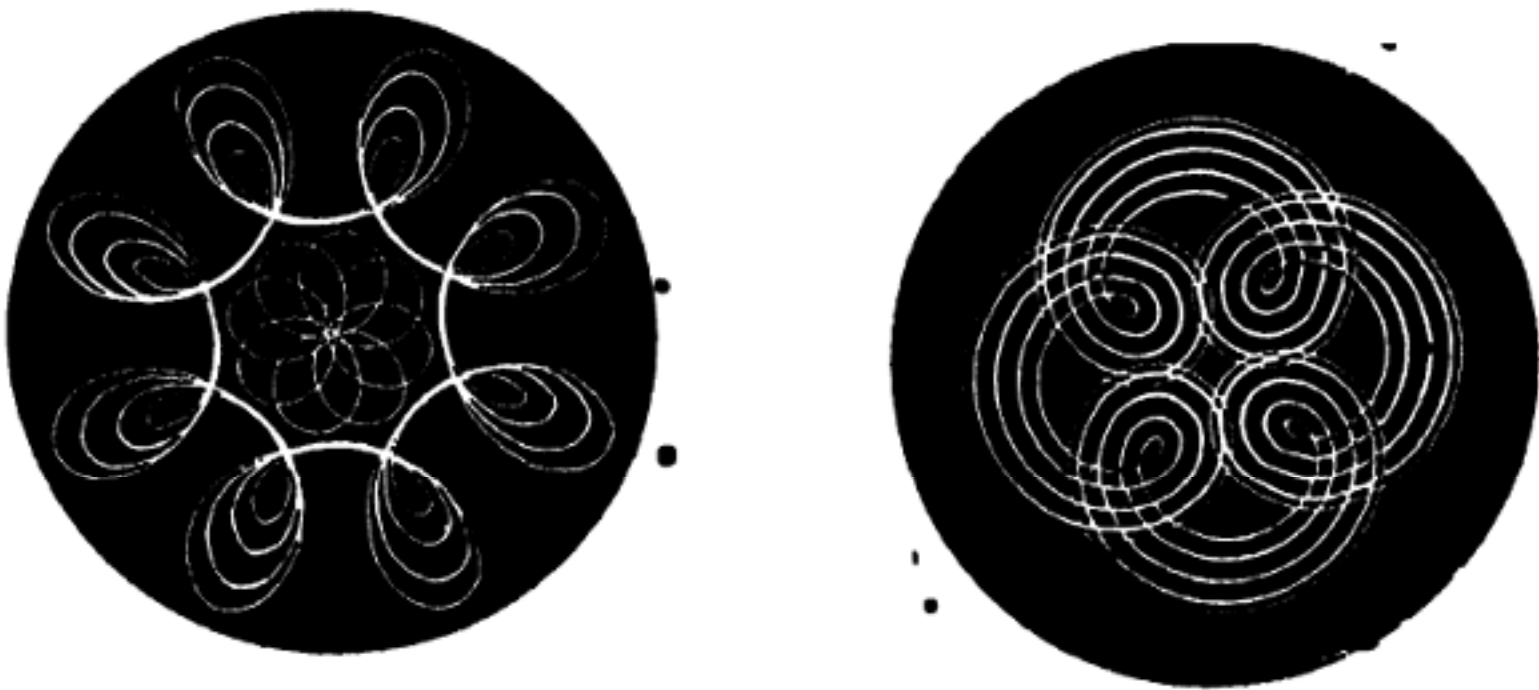
SIR.—Looking over the first volume of your valuable work, (p. 208,) I see directions for composition ornaments for picture frames; the following is an infinitely better receipt, and in hopes it may be useful, I send it for insertion:—1 pound of glue, 1 pound of crude-turpentine, half a pint of boiled oil, half a pint of water, and as much finely-sifted gilder's whitening as it will absorb, mixed up much stiffer than oil putty. It is an improvement if a quarter of a pound of common yellow soap, and a small quantity of flour is mixed with it. Brimstone moulds are oiled and the composition pressed in with the hand and afterwards put under a screw press. If they have no press it may be pressed in and rolled over hard with a silk roller wetted and pressed on a board; let it remain about a quarter of an hour, then the mould is gently raised off by means of a tool put underneath. The ornament is then cut off by means of a large carving knife and glued on the frame. I have used it for the last twelve years and never yet found it crack. Moulds cast in lead or brass is to be preferred to brimstone, as they last as long as carved ones, and in warm weather hardens the composition sooner.

O. FURNESS.

Fig. 1.



WILCOX'S CIRCLOIDAL CHUCK.



WILCOX'S CIRCLOIDAL CHUCK.

SIR,—I send you a drawing and description of a chuck, applicable in such a variety of ways, that I think you will deem it worthy an insertion in your valuable Magazine. It is capable of turning the straight line, the oval, the eccentric, and the cycloid. I also send with it two or three specimens of its simplest work; but to enter into a description of all it is capable of would require a volume.

I will preface my describing the chuck, of which the drawing, I trust, is clear enough to convey a tolerably correct idea, by saying, that in the description no reference is made to the wheel S, the chuck being complete, as a chuck, without it; but its value is very great in respect to its having the same number of teeth as E. Its object is to reverse the motion of the principal wheel; and without disturbing any of your previous arrangements of the chuck, it exactly thereby doubles the capability of the chuck; as with the wheel S all the loops of the cycloid are outwards, and without it inwards; see Fig 1. On the mandril is mounted (by means of a screw at the back) a brass plate, A, which I call the foundation plate of the chuck; behind this is the toothed wheel B, the spindle of which passes through the slide C, and carries the pinion D. The pinion D is fixed on a square of the spindle B, and turns with it; and as this pinion is changed at pleasure for others, of which there are five, with different numbers of teeth, it is requisite that it may be withdrawn or brought near to the wheel E. C is therefore a slide which is concentric with the centre of the chuck, having a slot which it moves in, and is fixed at any point by the nut F; D being slightly put on without its nut, until the required distance is ascertained; and F being tightened to secure it in its place, it is then taken off again, and the screw G is turned firmly; for when in action, the resistance of the cogs have a strong tendency to force the slide back in its slot, thereby dis-

engaging the cogs; but this is not always the case, because some of the different wheels D (which I have termed pinions) are small enough not to cover the head of the screw G; when this is the case, this double proceeding is not necessary. A similar slide to C is at the back, and through it the screws F and G pass. H is a plate of brass whose centre of movement is the same as the wheel E. I is a powerful nut to a bolt which has a large head, and which passes through a slot in the plate A, but which cannot be seen in front. This slot is concentric with the centre of the wheel E; when this nut is released the plate H can be removed to any distance of eccentricity, as is shown by the index on A, to which H, and consequently K, is moved; and this eccentricity is regulated with ease by the screw R. L is a stop secured by two screws, which, when the plate is against it, brings the moveable nose of K to the true centre of the mandril. M is a piece of brass with two cogs cut into it, and by turning the screw N it can be advanced or returned, moving in a short slot in H, and engaged in the principal wheel P, partially seen under the plate O. When these two teeth are engaged in this wheel, and the wheel D is taken off the spindle, the plate H resting against the stop L, the chuck then runs true to its centre; and any object fixed upon K can be turned true in surface, preparatory to being ornamented. The moveable nose K passes through the plate O. O being countersunk to the size of K, and being secured to H by the four nuts, *a a a a*, having pillars under them whose length is the thickness of P, secures its steadiness; and being firmly fixed to the principal wheel P, it consequently takes any movement given to P. The centre of P enters into the plate H, which is also countersunk to receive a similar projection to K, by which any shake is prevented.

Fig. 2 is a slight view of the back, to explain such parts as are not seen in the front, marked with the same letters.

Fig. 2.

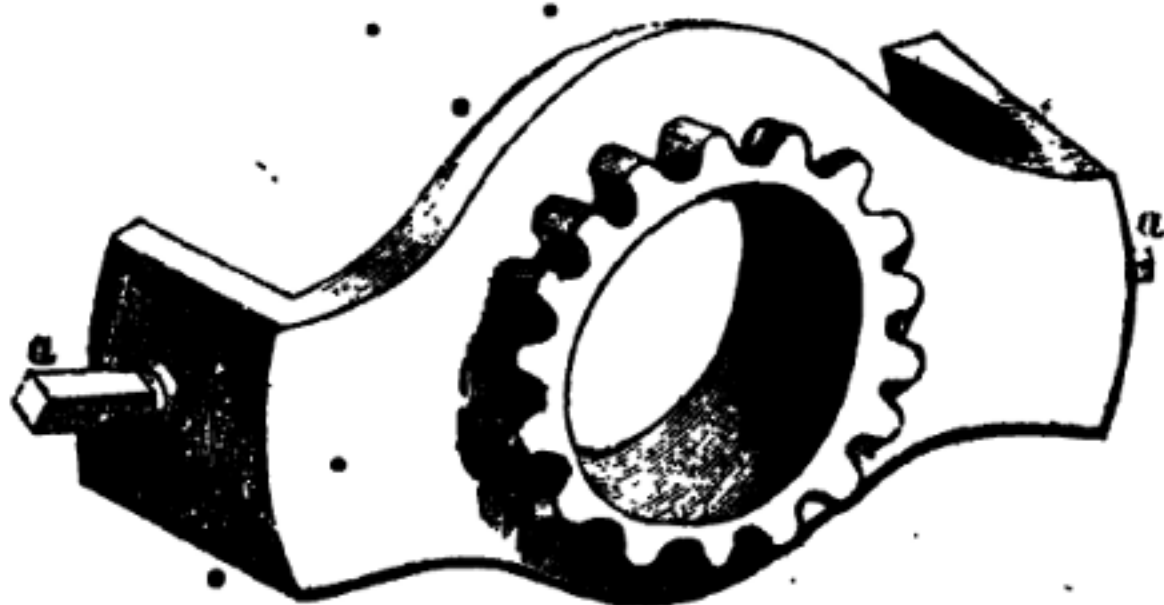


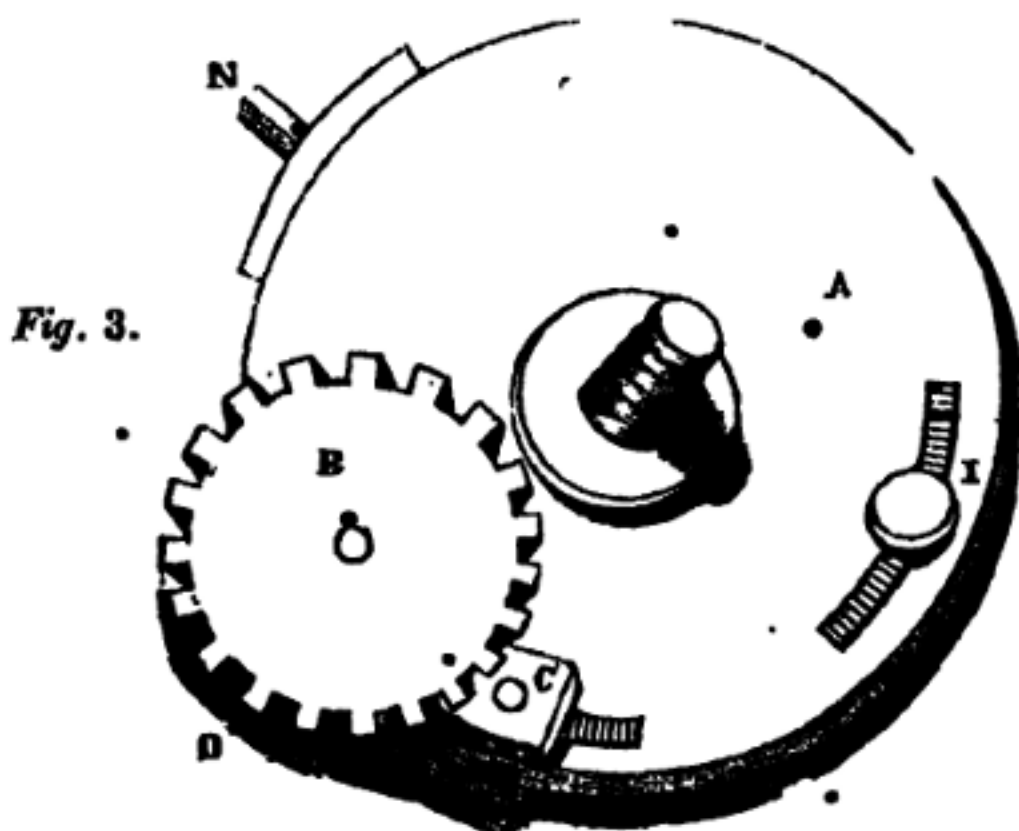
Fig. 3 is a wheel which is secured by the screws *a a* on to the collar of the mandril, into indentures made for that purpose in it; the mandril passing through the centre. Of these wheels there are two, the uses of which now remain to be explained, the one having 18, the other 27 teeth.

For the practice of the chuck, suppose the toothed wheel, Fig 2, is fixed on the collar of the mandril, the mandril turning through it, and this wheel having 27 teeth. The chuck being screwed on the mandril, the teeth of wheel B engage in it, B having also 27 teeth; these two will of course

move at the same pace. On B is fixed D, D and B having each 18 teeth, and P the principal 36; consequently, D's number of teeth being one half of P's, two revolutions of the mandril will be required to turn K once, and of course the tool's point will mark two loops in the face of the subject then on K. If D is changed for one of 12 teeth, it being one-third of P, three loops will be given. We will now suppose Fig. 3 is exchanged for the other similar wheel having 18 teeth, and B exchanged for another having 36; this will cause the chuck to be retarded in its motion one-half: consequently, there

will now be two places for retarding the motion of the chuck, and therefore the difference between the number of teeth of D and P must be twice doubled to find the number of loops given. The pignons having respectively 6, 9, 12, and 18 teeth—6 being one-sixth of P, will give 12 loops; 9, being one-fourth, gives eight; 12, being one-third, gives six; and 18, being half, gives four: therefore this chuck, by the various changes, will give on the face of any object mounted on K, two, three, four, six, eight, and twelve loops, both outwards and inwards. But one peculiarity attends the circumstance of the three wheels, D, S, and E, having each the same number

of teeth, that it will then turn the circle, the oval, and the straight line. The variety which each is capable of almost exceeds any person's ideas; by the changes of eccentricity, the distances from the centre, and also by the position of the tool in the slide rest; again, by taking off D, and moving E backward or forward one or more teeth at pleasure, a new point is given, and the cycloids intersect each other. But I will cease to give farther description of its endless powers. Add the overtop work and the stops of the divided plate on the mandril pulley, and a new field is opened.



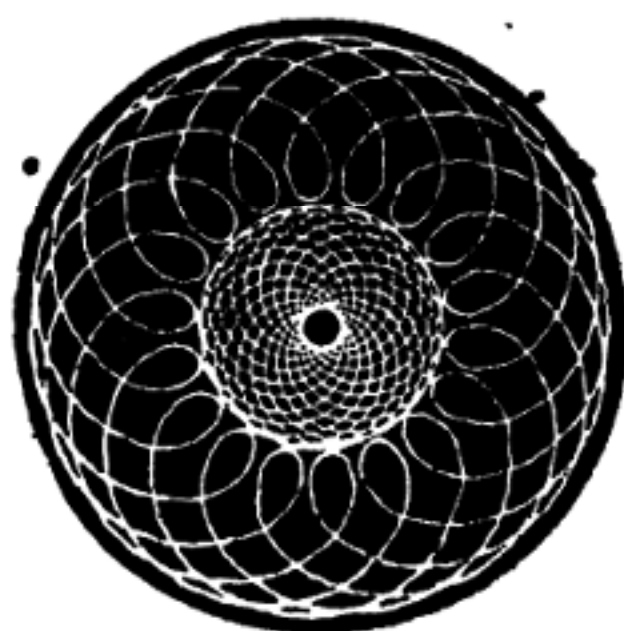
It may be requisite to observe, that a piece of metal projects from the foundation plate, on which is fixed a spindle; on to this the wheel S is put when required, its position being such that it engages its teeth into the driving wheel D, and is also in the line of the slot, so that those wheels which I have termed pinions engage themselves in it, when pushed up, as shown in the drawing.

I have endeavoured to give an explanation of this comprehensive chuck, and I hope I have succeeded; but there is an additional circumstance attending some other wheels attached to it, not yet noticed, and I cannot so well explain the cause of their action. I am no mathematician, but will endeavour to explain it in a humble way, for the use of those who may choose to make such a chuck, that they may have any number of loops they please, admitting the number they desire to have multiply by

any figure or figures to such an amount, however remote, as the number of teeth of the principal wheel will multiply into; premising first, that the multiplier of the desired number to be obtained is the number of cogs of the pinion. I will give two examples:—I wish with this chuck to have nine loops; I work it thus— $16 \times 9 = 144$, my principal wheel has teeth, $36 \times 4 = 144$; therefore a pinion to produce nine loops requires 16 teeth. Again, I desire 36 loops, $10 \times 36 = 360$; therefore 10 teeth to the pinion gives 36 loops.

I think I have now said enough to show that there is no end to the capabilities of this chuck, and that for ornamenting a piece of work it is sufficient of itself. I have been some years in making variations to bring it to its present state.

JAMES WILCOX.



VARIETIES OF THE HUMAN SPECIES.

ALTHOUGH the human species would appear to be single, there are, nevertheless, certain hereditary peculiarities of conformation observable, which constitute what are termed *races*. Three of these in particular appear eminently distinct: the *Caucasian*, or white, the *Mongolian*, or yellow, and the *Æthiopian*, or negro.

The Caucasian, to which we belong, is distinguished by the beauty of the oval which forms the head; and it is this one which has given rise to the most civilised nations,—to those which have generally held the rest in subjection: it varies in complexion and in the color of the hair.

The Mongolian is known by his projecting cheek-bones, flat visage, narrow and oblique eye-brows, scanty beard, and olive complexion. Great empires have been established by this race in China and Japan, and its conquests have sometimes extended to this side of the Great Desert; but its civilisation has always remained stationary.

The Negro race is confined to the southward of the Atlas chain of mountains: its color is black, its hair crisp, the cranium compressed, and nose flattened. The projecting muzzle and thick lips evidently approximate it to the apes. The hordes of which it is composed have always continued barbarous.

The name *Caucasian* has been affixed to the race from which we descend, because tradition and the filiation of nations seem to refer its origin to that group of mountains situate between the Caspian and Black Seas, whence it has apparently extended by radiating all around. The nations of the Caucasus, or the Circassians and Georgians, are even now considered as the handsomest on earth. The principal ramifications of this race may be distinguished by the analogies of language. The Armenian or Syrian branch, spreading southward, produced the Assyrians, the Chaldeans, the hitherto untameable Arabs, who after Mahomet expected to become masters of the world; the Phœnicians, the Jews, the Abyssinians, which were Arabian colonies, and most probably the Egyptians. It is from this branch, always inclined to mysticism, that have sprung the most widely extended forms of religion. Science and literature have sometimes flourished among its nations, but always in a strange disguise and figurative style.

The Indian, German, and Pelagic branch is much more extended, and was much earlier divided: notwithstanding which, the most numerous affinities have been recognized between its four principal languages—the Sanscrit, the present sacred language of the Hindoos, and the parent of the greater number of the dialects of Hindostan; the ancient language of the Pelagi, common parent of the Greek, Latin, many tongues that are extinct, and of all those of the south of Europe; the Gothic, or Teutonic, from which are derived the languages of the north and north-west of Europe, such as the German, Dutch, English, Danish, Swedish, and their dialects; and finally, the Slavonian, from which are descended those of the north-east, the Russian, Polish, Bohemian, and that of the Vandals.

It is by this great and venerable branch of the Caucasian stock, that philosophy, the arts and sciences, have been carried to their present state of advancement; and it has continued to be the depository of them for thirty centuries.

It was preceded in Europe by the Celts, whose tribes, once very numerous, came by the north, and are confined to its most western extremities; and by the Cantabrians, who passed from Africa into Spain, and have become confounded with the many nations whose posterity have intermingled in that peninsula.

The ancient Persians originated from the same source as the Indians, and their descendants still present a very close resemblance to the nations of Europe.

The Scythian and Tartar branch, extending first towards the north and north-east, and always wandering over the immense plains of those countries, returned but to devastate the happier abodes of their more civilised brethren. The Scythians, who, at so remote a period, made irruptions into Upper Asia; the Parthians, who there destroyed the Greek and Roman domination; the Turks, who there subverted that of the Arabs, and subjugated in Europe the unfortunate remnant of the Grecian people, were all offsets from this branch. The Finlanders and Hungarians are tribes of the same division, which have strayed among the Slavonic and Teutonic nations. Their original country, to the north and eastward of the Caspian Sea, still contains inhabitants who have the same origin, and speak similar languages; but these are mingled with many other petty nations, variously descended, and of different languages. The Tartars remained unmixed longer than the others throughout that extent of country included between the mouth of the Danube to beyond the Irtisch, from which they so long menaced Russia, and where they have finally been subjugated by her. The Mongoles, however, have mingled their blood with that of the nations they conquered, many races of which may still be found among the inhabitants of Lesser Tartary.

It is to the east of this Tartar branch of the Caucasian race that the Mongolian race begins, whence it extends to the Eastern Ocean. Its branches, the Calmucks and Kalkas, still wandering shepherds, traverse the Great Desert. Thrice did their ancestors, under Attila, Genghis, and Tamerlane, spread far the terror of their name. The Chinese are the most anciently civilised branch, not only of this race, but of all known nations. A third branch, the Manchures, have recently conquered and still govern China. The Japanese, Coreans, and nearly all the hordes which extend to the north-east of Siberia, subject to Russia, are also to be considered, in a great measure, as originating from this race; and such also is deemed to be the fact with regard to the original inhabitants of various islands bordering on that archipelago. With the exception of some Chinese literati, the nations of the Mongolian race pertain generally to different sects of Buddhism, or the religion of Fo.

The origin of this great race appears to have been in the Altai mountains, as that of ours in the Caucasus; but it is impossible to trace with the same certainty the filiation of its different branches. The history of these wandering nations is as fugitive as their establishments; and that of the Chinese, confined exclusively to their own empire, furnishes little that is satisfactory with respect to their neighbours. The affinities of their languages are also too little known to direct us in this labyrinth.

The languages of the north of the peninsula beyond the Ganges, as well as that of Thibet, bear some relation to the Chinese, at least in their monosyllabic structure; and the people who speak them

are not without resemblance to the other Mongoles: but the south of this peninsula is inhabited by Malays, whose forms approach them much nearer to the Indians, and whose race and language are distributed over the coasts of all the islands of the Indian archipelago. The innumerable small islands of the Southern Ocean are also peopled by a handsome race, who appear to hold a near relation to the Indians, and whose language has much affinity with the Malay: but in the interior of the larger islands, particularly in the milder portions of them, there exists another race of men, with black complexions and negro faces, all extremely barbarous, which are named Alfourous; and on the coasts of New Guinea and the neighbouring islands, are other negroes nearly similar to those of the eastern coast of Africa, which are termed Papous; to the latter are generally referred the natives of Van Dieman's Land (now rapidly approaching to extermination), and those of New Holland to the Alfourous.

Neither the Malays nor the Papous are easily referable to either of the three great races; but can the former be clearly distinguished from their neighbours on both sides, the Caucasian Indians and the Mongolian Chinese? We avow that we cannot discern in them sufficient traits for that purpose. Are the Papous Negroes, which may formerly have strayed into the Indian Ocean? We possess neither figures nor description precise enough to enable us to reply to this question.

The inhabitants of the north of both continents, the Samoyedes, the Laplander, and the Esquimaux, are derived, according to some, from the Mongolian race; but others regard them as mere degenerate offshoots from the Scythian and Tartar branches of the Caucasian race.

The Americans have not yet been referred clearly to either of the races of the eastern continent; nevertheless, they have no precise or constant character which can entitle them to be considered as a particular one. Their copper complexion is not sufficient: their general black hair and scanty beard would induce us to approximate them to the Mongoles, if their defined features, their nose as projecting as ours, their large and open eyes, did not oppose such a theory, and correspond with the features of the European. Their languages are as numberless as their tribes, and no demonstrative analogies have as yet been obtained, either with each other, or with those of the ancient world.

REGISTER OF THE SUMMERS OF LATER YEARS.

- 1816. Extremely cold and wet throughout; one of the worst harvests ever known.
- 1817. Very cold and wet in July and August, but extremely fine in September, which favored the harvest.
- 1818. Intensely hot and dry; the thermometer twice at 89° , and often above 80° .
- 1819. A very fine hot summer; the month of August intensely warm; scarcely any thunder.
- 1820. A fine summer on the whole, and very productive.
- 1821. Some very hot days occasionally, but for the most part cold and showery. Immense rains during harvest, which did great damage.
- 1822. A splendid year; hot and dry for the most part, but heavy rain at times, with much thunder. A very abundant harvest.

- 1823. A cold showery summer. In July it rained every day except the 24th; very little thunder.
 - 1824. Very fine and warm throughout, but never intensely hot. The thermometer stood highest September 1st, and was at 79° .
 - 1825. Very hot almost throughout. July 18th, the thermometer stood at 90° , which is the highest observation in the course of all these summers.
 - 1826. The hottest and driest summer ever known; it began early, and continued late. The thermometer was twice at 88° , and often at 84° .
 - 1827. Hot and dry, but not to such extremity as in the preceding summer; much thunder.
 - 1828. Immense rains, which began July 9th, and continued almost without cessation. Large floods July 16th and 30th. Heavy thunderstorms; bad harvest.
 - 1829. A very cold, stormy summer. In September the rains were extremely heavy.
 - 1830. Very cold and wet, especially in June; much thunder.
 - 1831. Warm, gleamy, showery, and electrical. A sickly summer; great number of insects, especially house-flies.
 - 1832. Moderate for the most part, without much inclination either one way or the other.
 - 1833. Very fine, the early part especially; an abundant harvest.
 - 1834. A fine genial summer, but heavy rains in the end of July. An early and productive harvest.
 - 1835. Hot and dry, with some showery exceptions. Another abundant harvest.
 - 1836. Very variable in different parts of the kingdom. In the midland counties, dry weather predominated. Remarkable for the almost entire destruction of the turnip crop by the fly. Harvest not amiss.
 - 1837. A fair average of hot weather, but preceded by a very severe spring. Harvest deficient.
 - 1838. A cold wet summer, and a late unproductive harvest.
 - 1839. Very heavy rains, almost without cessation. A large flood August 2, and smaller ones frequent. The harvest not unproductive, but much damaged.
 - 1840. A fine warm summer, with intense heat in August; fine harvest weather, but seed deficient from the want of rain.
 - 1841. Fine and warm in May and June; wet and cold in July and the beginning of August; fine harvest weather at the end, and in September.
- P. L. Simmonds; Quart. Journ. Meteor. Society.*

ON THE USE OF GUANO, &c.

BY W. H. POTTER, M.B.A.S.

GUANO presents to us an object of study exactly suited to our purpose. It is only very recently that we have heard of this substance, and until the last few months specimens were to be seen only in the chemist's laboratory, or in the cabinets of the curious. Humboldt seems to have been the first person who brought any to Europe, and the celebrated Klapproth the first chemist who examined it by analysis. Although the fertilising properties of guano, when applied to the sandy and sterile soils of Peru, have been known for years, yet hitherto, arising from the difficulty and expense of obtaining it, or from carelessness and apathy, it is but very lately that experiments have been made with it in

this country. Those which have been made fully bear out the accounts of its remarkably fertilising effects conveyed to us by travellers, and justify the opinion that its extended employment will be productive of immense benefits to the interests of agriculture.

The word guano is of Peruvian origin, signifying manure. It seems to have been known, and its virtues appreciated, by the Peruvians, during six or seven centuries. Without its aid, nothing could grow on their arid and parched soil; with it, rich crops of wheat, maize, and potatoes, and even fruit-trees, are grown to perfection. It occurs as a deposit, of very considerable thickness, on various small rocky islets off the coast of Peru, ranging from the 13th to the 21st degree of south latitude. Its origin has been a subject of fanciful speculation, but now it is known to be the excrement of a peculiar kind of sea-fowl, which, feeding on fish, and visiting these islands in flocks dense enough to obscure the light of the sun, have accumulated their droppings to almost an incredible extent. Winterfelt assigns a thickness of 300 yards to some of these accumulations. In estimating the value of guano, it is necessary to bear in mind that there are two or three varieties, differing much in quality and in appearance. The recent droppings (the white variety) are by far the most valuable, while the ancient, or red variety, is very inferior, having lost much of its virtue by age and exposure.

It seems probable, from the avidity with which the white or recent dung is collected almost as soon as deposited, that very little will find its way to Europe, and that the red or brown varieties will be those only with which we shall have a chance of being acquainted. About 1,000 tons per annum are consumed by the Peruvians. It may be purchased at the rate of 20s. per cwt. From among the numerous analyses of guano, we select those of Klaproth and Johnstone; and we do this for a twofold purpose—to show its composition, and consequently what are the matters to which it owes its fertilising properties; and to point out how variable is its constitution, and how impossible it is that experiments made with it can be compared together:—

Klaproth found in 100 parts—

	Parts.
Urate of ammonia	16
Phosphate of lime	10
Oxalate of lime	122
Silica	4
Common salt	1
Sand	28
Water, organic and combustible matter	282
Parts	100

Johnstone found in 100 parts—

Ammonia	7.0
Uric acid	0.8
Water, carbonic and oxalic acids	51.5
Common salt, with a little sulphate and phosphate of soda	11.4
Phosphate of lime	20.3
Parts	100

Farmer's Magazine.

STAINED GLASS IN WINDOWS.

THE earliest mention of colored glass in windows, that can be depended on, occurs about the middle of the ninth century. The materials were most probably worked into some pattern similar to those which had previously been adopted for the works in mo-

saic. That no example of so early a date remains is not at all surprising; the buildings themselves are more than problematical. The succeeding style was a rude attempt at the representation of the human figure, in which the several colors of the flesh and draperies were somewhat relieved either by strong black lines, or, if the representation was on a large scale, by the lines of division. Some glass of this kind formerly existed in the church of Poissy, the features of the faces themselves being expressed by lines of lead. In these early examples the flesh was represented by glass of a palish purple color.

The stained glass in the aisles of the choir of Canterbury cathedral is most probably the earliest remaining in this country, and appears to be of the early part of the twelfth century: the extent of it is yet considerable, and its effect extremely beautiful. The general designs consist in panels of various forms, containing subjects from holy writ, with explanatory inscriptions: these are on grounds either of ruby color, or of a rich deep blue, the depth of the latter color being a distinctive mark of the earliest glass. The spaces between these panels are filled with rich mosaic patterns of various colors, but still the ruby and deep blue predominate. The whole design is surrounded by a broad border of elaborate construction, and formed in brilliant tints. The centre window of Becket's *Crown*, in the same cathedral, appears to be somewhat later. This is chiefly composed of scroll patterns designed with very considerable elegance, the foliage being of various colors on a bright ruby ground. The earliest windows now remaining in the abbey of St. Denis closely resemble some in Canterbury cathedral; these were undoubtedly of the beginning of the twelfth century.

A most glorious example of the stained glass of the thirteenth century yet remains in La Sainte Chapelle, at Paris; and the effect of a building entirely illuminated by windows completely filled with the richest and most brilliant tints is only to be enjoyed and appreciated in that beautiful edifice. The style of the glass differs but little from that which preceded it, but the openings being narrower, there was only space for entire panels one above the other, half compartments attached to the sides being placed between. The general ground is of rich mosaics, and the broad lustrous borders still continue in use, but in these we find for the first time that the ornaments have become somewhat heraldic, the Fleur de Lis and Castle, the emblems of France and Castile, being profusely spread about. The blue color in these windows is not of so deep a tint as in the earlier glass.

The next variation appears to be the omission of the mosaic grounds; the detached panels are yet continued, and when these are occupied by the figure of king, saint, or benefactor, some plain kind of canopy is placed above them. The ground of the whole window is composed of a trailing pattern formed either of ivy, vine, or oak, thrown with considerable elegance through the various spaces: these ornaments are sometimes indicated only by a delicate outline, at other times are stained of a yellow tint on a ground of subdued white. Some interesting specimens of this kind remain in the windows of the north aisle of the nave in York cathedral. The five windows in the north transept of the same church must have been extremely splendid; in these the ornament consists entirely of the foliage ground, intersected by colored bands arranged in various ways. The side windows in the choir of Merton

college chapel, and others in the choir of Norbury church, Derbyshire, may be referred to as slight varieties from the previous examples: in the latter church richly emblazoned shields are introduced with very beautiful effect; the particular laws by which heraldic colors are contrasted invariably produce a full and perfect effect in stained glass. The blue continues to get lighter, and of a tint more inclined to grey.

In the fourteenth century the elaborate minuteness of the designs had disappeared; the openings of the windows were now generally occupied by one figure only, an effigy of the patron saint; or benefactor, placed on a ground of one entire color, which was richly diapered by a relieved pattern; the whole under a canopy of considerable pretensions. The finest examples of this style are in the nave of the cathedral at Strasburgh. Heraldry at this time had made considerable advances in the occupation of the subject: the noble or the knight was generally represented in his armorial *just au corps*, and frequently as holding the emblazoned banner of his house. The windows at the east end of Tewkesbury abbey may be cited as examples to illustrate this style.

In the fifteenth century the artist, disdaining to confine himself, as his predecessors had done, to the narrow limits of a single opening, frequently carried his design through the whole extent of the window, his subject embracing a considerable number of figures arranged with more pictorial effect than heretofore. The several tints of the colored glasses were more varied, and placed with consideration as to the effect of distance; the shadows were more graduated, and aerial perspective attempted. The windows in Fairford church, Gloucestershire, are very superior specimens of this style, particularly the great western window, containing a very fine and effective representation of the last judgment. When figures of the saints, apostles, or martyrs, were introduced, they were now generally accompanied, either by the animal considered peculiar to them, or represented as bearing the instrument of their martyrdom. Scrolls, with long inscriptions in the black letter, were often thrown with wild profusion across or above the figures. In the north transept of Canterbury cathedral are considerable remains of what must at one time have been a very fine window of this time. The openings have been occupied chiefly by portraits of king Edward the Fourth, his queen, and family, and by richly colored shields of considerable size. In the chapels on the east side of the transepts, in the same cathedral, there yet remains some glass of this period, in which, excepting some small shields, the whole of the ornaments are entirely executed in brown and yellow; the effect, as may be supposed, is weak and insipid.

In the sixteenth century we would cite the magnificent stained glass which decorates the chapel of King's college, Cambridge; and the east window of St. Margaret's church, Westminster, stands as a worthy contemporary. Some whole-length figures now remaining at the east end of the abbey church of Westminster, could not have been intended originally for that situation; the elaborate beauty of the figures, which would have been appreciated if placed nearer to the eye, tends considerably to mar the effect that would be desirable at the distance from which they are now viewed; their dimensions are too great in width, or it might be supposed that they had originally been intended for some lower windows of king Henry the Seventh's chapel. In

this latter building we now find only some heraldic devices within colored panels, the general ground of the windows being in quarries, each decorated with a crowned letter. In the church of Gonda, not far from Rotterdam, there is yet extant a considerable number of large windows, of various degrees of merit, and dating from the beginning of the sixteenth to the middle of the seventeenth century: in these one subject occupies the whole space, the distance being piled up nearly to the top of the several openings. An account of these has been published, which gives the several dates, and the names of the respective artists. The windows on the south side of the chapel in New College, Oxford, are very favorable specimens of this time, as far as their monotonous tint would permit. Those on the opposite side, executed by Peckitt of York, are most miserable; this artist was, however, very successful in the manufacture of his colored glasses, and excelled in their brilliant combination into rich mosaic patterns. His best windows are in the private chapel at Clumber in Nottinghamshire; and were executed by him for the grandfather of the present Duke of Newcastle: they are said to have been most costly. His large window at the west end of Exeter cathedral has already suffered severely by the action of the atmosphere.

At the Reformation, the objection to the invocation of saints not only impeded the progress of the art, but unfortunately proved an excuse for the destruction of some of the finest work which had remained until that time: the subsequent rule of the fanatics was however still more destructive. Some stained glass of a very pleasing design, executed during the reign of James the First, remains in the church at Blisnam, in the county of Berks; it has, however, no particular church character about it, and might with as much or more propriety have been used as the decoration of a mansion. The execution of large scripture subjects appears to have been nearly dormant until after the restoration. The general adoption of the classical orders of architecture had contributed greatly to the disuse of stained glass; but after the return of Charles the Second to the throne, a feeling of opposition to the frigid style of the puritans and their conventicles probably contributed essentially to the semi-vitality which for some time appeared to animate this drooping art. The resettlement of the colleges at this period induced many munificent benefactors to step forward; and about this time Van Linghe the younger and Isaac Oliver appear to have been very extensively employed; their works at Oxford bear evident marks of the carelessness or haste with which they were executed, and of the very imperfect manner in which the colors were affixed on the glass. Perhaps the most conspicuous example of the imperfect manner in which the chemical part of the works of this time were executed is the east window of the chapel in University college, Oxford, which was put up in the latter part of the seventeenth century by Henry Giles of York.

Walpole did much by his writings and by his example, although Strawberry Hill may now be but the subject of a jest, in calling the attention of the public to the arts of the middle ages. He saw but the dawning of a better day; and we feel assured that at this time no one would hint at, much less advocate, the removal of so essential a portion as the mullions from a window, to make space for a semi-transparent picture, as we see in St. George's chapel, Windsor, in the chapel of New College at

Oxford, and in Salisbury cathedral. However well designed or executed such kind of works may be, their effect is not better than if painted on muslin: unfortunately their durability may be somewhat greater; they shock us in buildings of that character by the evident sacrifice of consistency and propriety which has created such space for them. Through the whole series of ancient examples we can distinctly perceive that the most effective specimens are those in which the design and arrangement is made subservient to the architectural features of the window in which they were placed. Stained glass ought properly to decorate the architecture, not supersede it.

SPRUCE BEER.

ALTHOUGH this beverage is known under the name of *beer*, it is in fact a wine as much as many others that are acknowledged as such. It is of two kinds, brown and white; the latter is by far preferable, and is made as follows:—Take seven pounds of the cheapest loaf-sugar; dissolve it in four gallons and a half of hot water. When the temperature has fallen to blood heat, mix in about four ounces of essence of spruce, and dissolve it perfectly by agitation. Then add half a pint of good solid yeast from a brewery, and mix thoroughly. A fermentation will soon commence which, if it be summer, will rapidly go through its stages; but if in winter, must be maintained by keeping the cask in a warm apartment. When the fermentation very perceptibly subsides, the liquor is to be drawn off, the cask well washed, and the liquor returned. A second fermentation, inconsiderable in degree, will take place, and when this diminishes the liquor is fit for bottling. The bottles should be wired down, and laid on their sides until the liquor becomes brisk and in high order. This will be known by a trial of a bottle; and it then becomes prudent to set the bottles on their end lest they should burst. When kept too long in this posture the beer is apt to become flat; in which case the bottles must be placed on their sides again. Brown spruce beer may be made exactly according to the same formula, except that in place of white sugar an equal weight of molasses or treacle is to be made use of.

COPYING ENGRAVINGS.

(To the Editor.)

SIR,—I have found the following methods of obtaining accurate copies of any engravings, plans, &c. very useful; and perhaps they will be so to many of your readers. By inserting them in your useful periodical, you will oblige, G. M. R.

Take a piece of good transparent oil silk, and place it over the engraving, &c. that you wish to copy. Trace lightly, with a steel pen and good common ink; when the ink dries, breathe on it; if a large subject, hold it over the vapour of warm water for a few seconds; then place a piece of clean paper on the tracing, and rub it with the hand; on taking up the paper an accurate copy will be found. Two copies can be taken from the same tracing.

Another method is as follows:—Grind a piece of window-glass on one side; place the smooth side on the engraving, &c., and trace on the ground side with a good black-lead pencil. Place a piece of

paper on the tracing, and rub briskly on it for a short time with a paper-knife; on taking up the paper, an accurate copy of all things delineated on the glass will be found on it. Two copies can be taken from the same tracing. Plans of machinery, &c., can be readily copied by either of these plans, also statues and engraved portraits, landscapes, philosophical apparatus, &c.

N. B. The silk can be washed with soap and water or water slightly acidulated, so that it will last for several years. The glass can be washed with water; the copies can be colored with Indian ink, &c. When a copy is required perfectly similar in position to the original, proceed as follows: trace as usual, then turn the silk and go over the tracings again on the other side; the copy from this will be in the same position as the original.

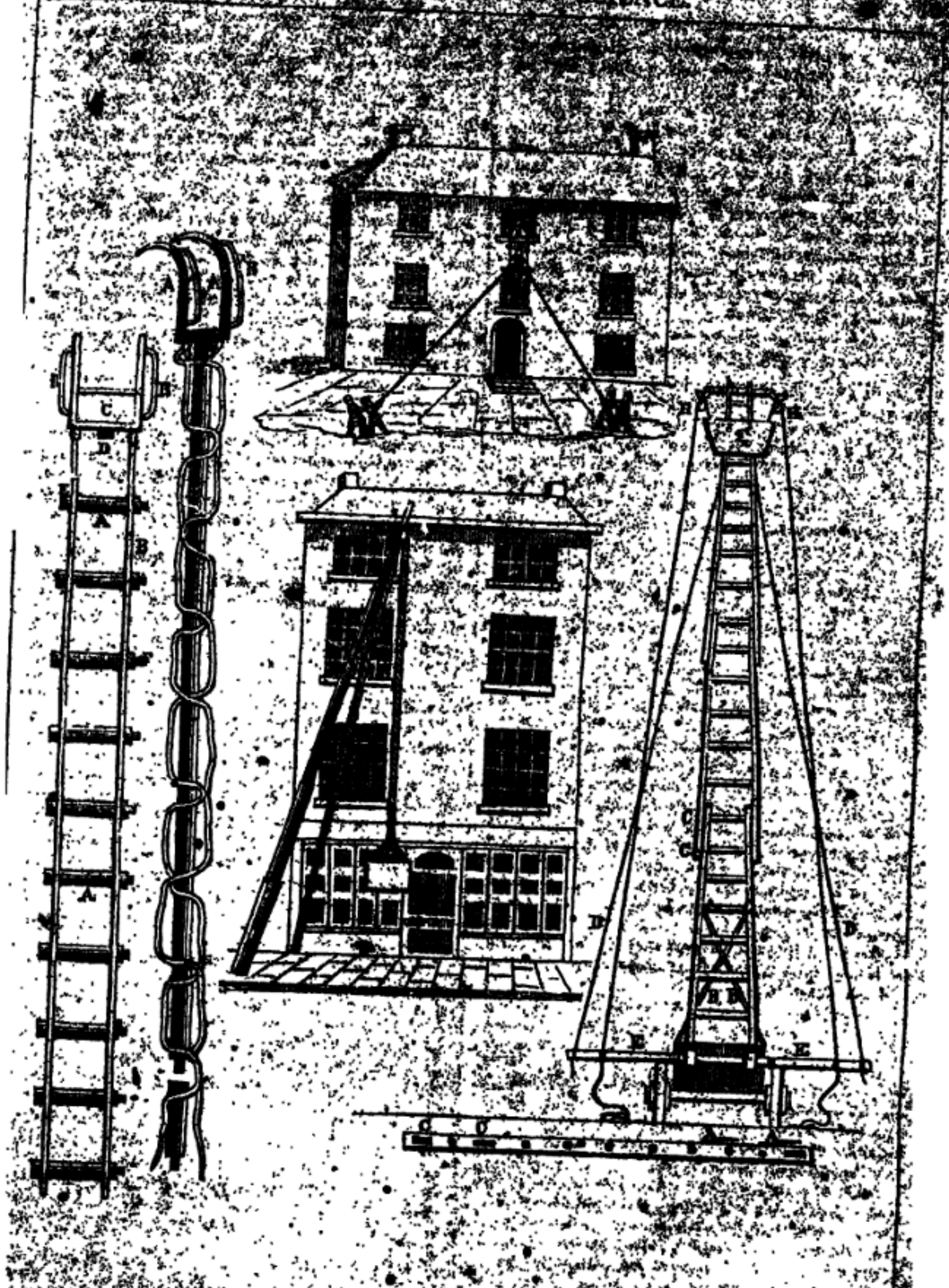
MEMORANDA.

Improvement in Signal Rockets, by J. Brunton.

—The heavier the rocket-case is, the larger and more weighty is the stick or balance required, which must of course, lessen the velocity of its ascent; and if the thickness of the case be diminished, the consequence will probably be that of the rocket hursting before any ascent takes place, from a want of sufficient strength to resist the pressure of the suddenly disengaged gases evolved by the inflammation of the combustible materials in the interior of the case. I have found, that by wrapping the outside of a thin case with moderately stout packthread, the effect gained was such that an "ounce" rocket ascended to as great an altitude as a "half-pounder" of the usual make, the increased velocity evidently resulting from the employment of a lighter rocket-case and consequently a lighter counterpoise. The packthread was wound close, and every where round the case, and for what is called an "ounce" rocket should be of about $\frac{1}{4}$ of an inch in thickness. The common kind used by shopkeepers answers extremely well and can be had at a low price. By comparison, I have found the spiral coil of twine to be infinitely cheaper than the cost of the immense mass of paper which would be required on the cases as ordinarily manufactured.

Substitution of Iron for Zinc in Electro-magnetic Apparatus, by Z. J. Rockline.—In all my electrotype experiments, I have employed, and with the greatest success, ordinary sheet iron instead of zinc for the positive metal,—than which it is much cheaper. The difference must, I think, be palpable in large electro-castings, where extensive surfaces of zinc would be necessarily requisite. Iron, in the form of cylindrical rods, which are extensively manufactured, would, if cut into suitable lengths, form most excellent and cheap substitutes for the zinc bars hitherto used in circular constant batteries. To electrotypists this metal, in whatever form it may be used, must prove a cheap substitute for zinc.

Flame.—It appears by some recent experiments of Mr. Skidmore, of New York, that the flame of the oxy-hydrogen blow-pipe may be made to burn under water. To this end it is only necessary that the flame should be submerged slowly, so that it may not recede into the vessel. The flame under water is *globular*! wood burns in it, and wires are ignited. Mr. Skidmore thinks it may be employed with success as a sub-marine instrument of naval warfare.



FIRE ESCAPES.

FIRE ESCAPES.

Few subjects have more extensively engaged the public attention, or exercised so much ingenuity, as the best mode of rescuing individuals from death by fire. Notwithstanding the varied talents that have been directed to this object, it is a singular fact, that no invention has yet been produced so universally efficient as to supersede all others, or to induce the belief that the limits of perfection have been attained. Many excellent and ingenious contrivances have been produced, most of which will be found embodied in the following classified description. Fire escapes may generally be divided into three classes: viz. ladders, portable escapes, and carriage escapes. With the common fire ladders all must be well acquainted; they are made of different lengths to reach a first, second, third, or fourth story window. When of the largest kinds they are generally furnished with iron guides or hand-rails at the sides, and also with a contrivance for raising them. This contrivance consists of a short conical iron tube, jointed to one of the upper rounds or steps of the ladder; a long pole fits into this tube, and affords great facility in raising the ladder. A well made ladder of bamboo, from its extreme lightness combined with the requisite strength, has been considered by some persons, admirably adapted for the purposes of a fire-escape. Another form of ladder, and one that is at present very successfully employed consists of short lengths, from eight to nine feet long, which fit one on the other to any required extent, by a strong, but simple joint, in the same way as scaling ladders. The advantages of this kind of ladder are, great portability and convenience, with all the practical utility of the longest and most unwieldy ladder. Mr. Gregory, whose numerous fire escapes have attracted deserved attention, has constructed a great variety of ladders; among them is a very pretty ladder, in two parts or lengths, one sliding upon the other, and sustained at any required elevation by a simple contrivance. A cradle is attached to this ladder, for the rescue of timid or infirm persons; the whole is of a convenient size for carrying or stowage, and is very easily managed.

Fig. 1 exhibits three of these ladders connected together, and applied as a fire-escape, with a light car or cradle, raised by ropes H H, working in pulleys attached to the top of the ladder. A set of these ladders may be placed on a light hand carriage, or might accompany each fire engine. On reaching a conflagration, the lower ladder is first raised, and the feet secured in their place by a bolt passing through them and two blocks, placed upon the engine for that purpose. The iron stays B B crossing each other are hooked into staples fixed in the back of this ladder. The first ladder being thus firmly fixed, a man mounts it and attaches another on the top of it; a third, fourth, or fifth, may in this way be added, until the required height is obtained. When the height is considerable two guy ropes D D are employed, to preserve the ladders in the proper position. For this purpose the back of the carriage is provided with two large square staples, through which the bar E is thrust; to the ends of this bar the ropes are made fast, as shown. The ladders are each precisely alike, so that all fit one another; they are connected by the following simple and effective contrivance. Two long hooks or half rings A A (Fig. 2), are fixed on the hook of each ladder by means of an iron strap, and riveted

through; each ladder is provided with two flat steps C C at its lower end, which drop into the two hooks and make a firm and secure joint. Rope ladders have sometimes been employed as fire escapes; the most common kind consist of strong rope sides, with wooden steps; circular pieces of wood are sometimes added to the ends of the steps to keep the ladder from walls, &c. In Edinburgh wire chain ladders are employed with great success, being used by men duly trained for that purpose.

The principal difficulty with all ladders of this description, is in raising them to the windows where they are required; this difficulty has been surmounted in the rope ladder of Mr. A. Young, the most ingenious and useful contrivance of this kind with which we are acquainted. It consists of a number of rounds A, Fig. 3, which form the steps of the ladder by being united with two ropes B B; these are suspended from an iron frame, C, terminating in hooks, which can very conveniently be lodged on the sill of a window, and thus form a secure support for the ladder. The principal peculiarity of this contrivance consists in making the ladder, so that the rounds or steps can be put together as shown at Fig. 4, forming a pole by which the frame C can be raised up to a window from below. To effect this, the ends E of the rounds A have ferules fitted fast upon them, and the other ends F are reduced so as to enter the cavities of the ferules, which project beyond the end of the wood, thus forming sockets for their reception. The iron frame C at the top has a projecting pin D, which fits into the socket E of the upper round; this supports it at the top. The small end of this step is inserted into the ferule of the second, which is again fixed to the top of the third, and so on to the bottom. In this way a pole is formed, as in Fig. 4, of all the steps of the ladder joined together, by which means the hooks at the top of the iron frame may be raised up to a window sill, and then a single jerk or pull at the lower end disunites the staves from one another, and they assume the form of Fig. 3, ready for ascending or descending. The side ropes of the ladders B B are composed of three small lines plaited together, which method gives the means of fastening the staves very securely to them. A hole is bored through the staff at the place where the rope is to be fixed, large enough to receive one of the three lines, and a groove is turned round outside of it at the same place. The frame C at the top has two iron rods B B fixed to its sides, which are useful as hand-rails to any person getting out of a window on to the ladder. The whole rolls up into a compact bundle, and is easily carried about. A ladder on the same principle may also be constructed entirely of metal, by using wire chains and metal tubes for the steps. Mr. Young received a silver medal and fifteen guineas from the Society of Arts for his invention.

The next class of fire escapes, comprising those of a portable description, is a very numerous one, and may be said to commence with a simple rope made fast to something within the room, by means of which a descent might be effected. It has been considered an improvement to knot the rope pretty closely, and descend by alternately changing the grasp, instead of letting the rope slip through the hand; it is but a limited number of persons, however, who could escape by these means. It has therefore been suggested to attach a sack to the end of a rope of sufficient length, into which females, children, &c. might be put and lowered in safety.

their descent being regulated by drawing the bed close to the window, and passing the rope once or twice round the bed post, which would generate friction enough to make the descent easy, without much exertion on the part of any person. Several improvements have been made upon this rude and simple apparatus, consisting in general of a cradle in lieu of the sack, made of a convenient form and suitable material, and in running the rope through a pulley hooked to a staple provided for that purpose; a guide rope is also attached to the bottom of the cradle, which enables it to be pulled aside from flames issuing from the lower windows, and from railings, areas, &c. In some cases the pulley is supported by a grappling hook thrown into the window. Escapes of this kind have been constructed by Messrs. Coblin, Cook, Fox, Hesse, Merryweather, Read, and some others, all similar in principle, but differing slightly in detail.

Mr. Davies invented a rope fire escape, possessing in an eminent degree the essential qualities of simplicity, efficacy, and portability. It consists of a long rope doubled, the two ends of which are secured to a strong iron hook, for the purpose of attaching it to a ring bolt screwed to the sash frame, or a beam in the ceiling. A number of loops, made of strong girth web, slide upon the double rope, by means of short copper tubes or eyes; these loops are also equipped with cloth slides. This, with a jointed rod for raising it to a window, comprises the whole of the apparatus. The mode of using this escape is as follows:—The end of the double ropes at which the sliding loops are all collected, is placed upon the forked extremity of the uppermost joint of the rope, a second is added, and so on, till the necessary elevation is obtained. The persons above having secured the hook to some suitable object, those below hold the ropes asunder, thus forming a triangle, the apex being at the window, and the base in the street. One of the persons above then takes one of the loops, and passing it over his head and shoulders, fixes it under his arms; he then gets out of the window, and commits himself to the rope, down which he slides to *terra firma*. As the ropes are in contact at the window, the descent is at first rapid, but, as the person gets lower, the greater divergence of the ropes gradually arrests his progress. There should be at least 6 or 8 persons holding the ropes, and they should be kept as wide apart as circumstances will permit; the base should always be upwards of three yards. This machine is shown in Fig. 5, and is being exhibited at this time in many parts of London. Females, children, &c. may be lowered by this escape with perfect ease and safety; for, by bringing the cloth slide on the loop close to the body, the person descending cannot quit the loop till released by withdrawing the slide. Mr. Barnard had previously proposed the employment of a wicker cradle sliding on divergent ropes. The principal difficulty attending the use of portable fire escapes, is in establishing a communication with the persons in danger; the most usual method of effecting this object is by rods about six or eight feet long, connected either by sliding rod or bayonet joints, or by screws. Fig. 6 shows a series of rods connected in this manner, which not only raise but also support a pulley upon which a cradle is worked; this arrangement, however, requires strong, and consequently very heavy rods, and therefore cannot be much recommended. Mr. Gregory effected a communication by means of a walking stick with those ex-

tending joints like a telescope, by which a line was handed to the persons in danger from the window of an adjoining house. Others have suggested the idea of dropping a line from the tops of the houses on each side of that on fire, which, attached to a rope, or escape of any kind, would enable it to be raised to those requiring its aid. Some persons have proposed to throw a ball with a line attached, into the window from the street, and thus form the desired connexion; this, however is a difficult, and random mode of proceeding, and by no means to be relied on in the time of danger. The Edinburgh firemen use a cross-bow, and a three-ounce leaden bullet, attached to a fine cord of the best materials and workmanship, 130 feet long. The bullet and cord are thrown over the house by the cross-bow; to this cord a stronger one is attached, and drawn over the house by the former, and so on, until a chain ladder or escape is eventually elevated. To act upon this plan, however, with any good chance of success, requires the men to be regularly trained for the purpose, as they are in Edinburgh, where they are exceedingly skilful in the management of all their fire machinery.

(To be continued.)

BLEACHING.

(Resumed from page 140.)

Washing.—It is never to be forgotten that between each of the several processes of steeping, bucking, souring, &c., the goods are to be thoroughly washed by the dash wheel in pure water, so that all the loosened impurities, as well as the detergents which have been employed, may be effectually removed. When any of these are left through defect of washing, they not only prevent the proper operation of the agents afterwards applied, but often leave in the cloth indelible stains. Besides, as it may through neglect become dry after bucking or souring, the salts will be condensed in proportion to the dryness of the cloth, and acting with greater force will destroy its texture. Soap is not employed except in the first washings and in finishing. Black or soft soap is found to be best for these purposes; brown soap leaving a yellowish tinge on the cloth. If these precautions are not attended to, the goods which are imperfectly washed will be in danger of becoming yellow instead of white, by immersion in preparations of chlorine; and even of acquiring a tenacious and disagreeable ruddy tinge, either partially if the washing has been partial or totally if it has been entirely neglected. The bleacher should be on his guard, not to soap cleared goods in the soapy solution which has been used for pieces taken out of a strong chlorine preparation, even though they have first passed through a sour or sulphuric acid. For this soapy solution does not fail to acquire the property of discoloring other goods, unless the goods which were soaped, after being taken out from the chlorine preparation, have been immersed for a long time in clear water. Washing should always if possible be performed immediately after bucking, while the goods are yet warm, as the dirt and refuse will then be easier removed than when they become cold.

Sorting, or exposure on the field.—It has been accounted a great desideratum in bleaching to find a method of finishing goods without exposing them on the bleach-green; as it consumes a great deal of time and labor, and keeps out of cultivation large tracts of good arable land. It was thought, at one

time, that the introduction of chlorine bleaching would supersede crofting, and it would do so in a great measure, were it practicable to apply it in a proper manner. But however great may be its facility in bleaching, it is scarcely possible to adopt it in an extensive manufactory to the exclusion of crofting, without very heavy charges in workshops and apparatus. This naturally follows, from what has already been remarked with regard to finishing the bucking process; and it is useful to take notice of it, as bleachers often let their goods lie in heaps for a considerable time before washing. The washing of goods after souring is sometimes admitted on the erroneous notion that the acid which adheres to the cloth is useful in giving activity to the oxymuriatic salts. Evils of which they are unaware, arise from this mode of management. For when the sulphuric acid thus left in the cloth meets with lime, it forms a sulphate, which becomes fixed in the pores of the cloth, and produces stains that crofting cannot remove. The prevalence of this may be seen by examining the kiers which are often covered on the inside with this pernicious sulphate; it can therefore only be economically adopted with such goods as are intended to receive what is called a half, or three-quarter white. It has certainly very much diminished the period which crofting was wont to require, and in this seems to consist the chief difference between the old and the new modes of bleaching.

The first thing which claims attention is the soil and situation of the bleach-green. A gravelly or sandy soil seems to be the best, as the water will pass quickly through a soil of this kind, and will increase the reflection of the heat, for the process depends on the evaporation which may thus be caused. For the same reason it ought to have a southern exposure, and if possible should rather be sloping than level. To prevent the water from becoming muddy, it should run in a channel paved with sand-stone.

When the cloth has been steeped and bucked, it is spread out on the field, and frequently watered for the first six hours, to prevent the condensation of any alkali which the washing may not have removed. Dry spots are then allowed to appear before any additional watering. Dr. Home thinks that it profits most by this exposure when near drying, as the evaporating particles come rather from the more internal parts than the surface, and that it is chiefly evaporation which operates, is inferred from the fact, that the upper is uniformly whiter than the under surface. That it loses together with its greyish tinge the remainder of the acids and alkalis, with which it has been treated, appears from the safety with which it may be afterwards dried. Soap when sliced down and exposed to the sun and air, with frequent waterings, will lose half its weight in a fortnight; the inference is obvious and need not be stated. From some experiments it appears that the sulphur of the leys is one of the substances which is evaporated in crofting, and we know that this always has a tendency to produce a yellow tinge.

It is supposed by bleachers, that exposure on the field has more effect in the months of March, April, and May, than in any of the other months. As this idea is universal, it is likely to be well-founded, although Dr. Home has endeavoured to account for it by the greater attention which is usually paid to goods at the beginning of the bleaching season. He states also that Mr. Christie, an experienced and enlightened bleacher, found the summer and autumnal

months to be more efficacious than those of spring. The same intelligent chemist remarks, that it is in consequence of its completing the bucking process by evaporating the salts which are combined with the loosening impurities, that crofting always follows every bucking and boiling. There are, strictly speaking, two modes of crofting: the goods are artificially watered from troughs of little canals; or, they are exposed to all the vicissitudes of the atmosphere, without artificial watering. The latter is called dry crofting.

Boiling.—Coarse linen cannot afford the time and labor, but particularly the quantities of alkali necessary for bucking and must undergo the shorter and more active operation of boiling. Although however it may seem to be the more active process, it by no means follows that it is the most efficacious; on the contrary, the ley is much thicker and darker after bucking than after boiling. As the heat continues longer at the degree of boiling, the leys used for the coarse cloth must be weaker than those used for the fine. There is not so much danger from heat in the coarse as in the fine cloth, because the former is of more open texture and will allow the ley to penetrate more speedily; but in the coarse cloths of a more close texture, the heat should be raised gradually to the boiling point. The effect of boiling raw cotton or linen in a diluted solution of caustic alkali, is to give the liquors a deep brown color and to destroy its causticity; and fresh portions of clear ley applied a second or third time will produce similar effects, but in an inferior degree.

In bleaching fine goods, boiling is among the finishing operations, and is only employed when the goods are nearly white in order to remove the disagreeable smell of the preparations. The ley in this case is composed of pearl ashes, or of pearl ashes and white soap. The boiling ought not to be urged with a brisk fire, but just kept barely at the boiling point. The goods must be completely covered with the ley, and kept from rising by a cross similar to that used in steeping, in order that they may be exposed equally to the action of the alkali or soap. In bleaching fine cottons, such as lawn grounds, books, and light jaconets, no pearl ashes are used, the ley being made wholly of soap.

Souring.—Since the time of Dr. Home, who introduced sulphuric acid souring, there has been but little improvement made in this department of the art of bleaching. It always follows the boiling in alkaline leys, and is among the finishing processes. The goods are removed from the dash wheel to the souring vats, and exposed to the action of the sulphuric acid, in the same way as they are steeped at the commencement of the operation. It assists and expedites the process very much, and the goods are dried before being put into the sour, for a reason which was formerly given in the directions for bucking, but for this there is not always time. The acid is to be diluted till it can be taken with safety into the mouth, so as to indicate to the strength of strong vinegar, or lemonade, may be tried by the hydrometer, and Mr. Parkes's tables, the specific gravity being proportioned and accommodated to the fabric of the goods. Irish bleachers use 100 parts of water to dilute one part of sulphuric acid; the French at Lyons use 60 to 1 by measure. The same precaution is to be taken here, as in bucking, with regard to the equal mixture of the acid and the water with which it is diluted, for as the acid is poured into the water, and the former being twice the specific gra-

vity of the latter, the acid will sink undiluted to the bottom; if care be not taken to agitate and mix it. Want of attention to this circumstance, was one of the causes which prevented the speedy introduction of this mode of souring when it was proposed, for the bleachers, being ignorant of the imperfect state of the mixture, fearlessly put in their goods which were speedily corroded. The goods are usually suffered to remain in the sour for twelve hours; if they are put in dry, a shorter period will be sufficient, and it will be farther expedited by having the water milk warm, or even as warm as the hand can easily hold in it. It is of the utmost consequence to have the remains of the acid completely removed after the souring, because if the cloth is allowed to dry before washing, the condensation of the acid will infallibly corrode it. The less the goods are pressed in the vat, the better they will be exposed to the action of the acid: it was probably want of attention to this, which gave rise to prejudices against the use of acids. Whether they are sufficiently cleared of it, may be ascertained by applying the tongue, when the absence or presence of an acid will indicate the continuance or discontinuance of the washing.

(To be continued.)

METAL AND WOODEN SPRINGS.

THE spring is, in a variety of pieces of mechanism, not only a very useful auxiliary, but in some (as in pocket-watches, gun-locks; &c.) an indispensable requisite. But from the difficulty of getting springs to stand, as the workmen express it, to their temper, they are not so frequently applied to the purposes of mechanics as otherwise they might be. Great judgment and skill, as every one knows who is conversant with the subject, are required to give to a metal spring its due degree of temper; for, if made too hard it snaps, if not hard enough it sets. Metal springs, however, frequently fail from another cause, which is very little understood, in consequence of which, the failure is usually attributed though, as will be presently seen, unjustly, to the unskillfulness of the workman. It is a circumstance not commonly observed respecting a metal spring, that if it have not something to stop against, but is suffered to vibrate after performing the requisite action, it will, in a short space of time, if the action be frequently repeated, either break or set; whence this property arises is not at present the object of inquiry. It is mentioned that, in cases which will admit of it, this inconvenience may be guarded against. In those cases in which the vibration cannot conveniently be avoided, a wooden spring, which is subject to the like inconvenience, is the best, and perhaps the only substitute. A wooden spring is in the property, alluded to the reverse of a metal one: if stopped in its vibration, it soon sets or breaks; if permitted to vibrate, its temper or elasticity suffers not the smallest diminution.

A gentleman some years ago, established a mill for a manufacturing purpose, in which, having occasion to apply springs under the circumstances mentioned above, he at first attempted to make use of metal ones, but in vain, being never able to make them stand a single day's work. He tried every kind of steel, and employed many different workmen, but still without success. Merely as a temporary expedient, till such time as he could get a fresh supply of steel springs, he one day tried a wooden one, which to his agreeable surprise com-

pletely answered his purpose; and from that time, as may be concluded, he never used any other than wooden ones. The experiment was perfectly decisive: the springs were in daily action for four years successively, making, in a common way, from forty to fifty strokes in a minute on an average. At the expiration of the four years those springs which had escaped accidents were as elastic, and as strong, as when first put into action. The wood they were made of was red deal, clean grained, and perfectly free from knots.

To many manufacturers who employ machinery for various purposes in which springs that must be suffered to vibrate, form a part, this information, which may to some appear trivial, will be found highly useful.

SPONTANEOUS COMBUSTION

MANY vegetable substances, highly dried and heaped together, will heat, scorch, and at last burst into flame. Of these, the most remarkable is a mixture of the expressed oil of the farinaceous seeds, as rape or linseed oil, with almost any dry vegetable fibre, such as hemp, cotton matting, &c. and still more so, if also united with lamp-black, or any other carbonaceous substance. These mixtures if kept for a time undisturbed, in close bundles, and in a warm temperature, even in small quantities, will often heat, and burn with a smothered fire for some hours; and if air be admitted freely, will then burst into flame. To this, without doubt, may be attributed several accidental conflagrations in storehouses, and places where quantities of these substances are kept. Indeed this has been proved by many experiments. The most important of these were made by Mr. George, and a committee of the Royal Academy at Petersburg, in the year 1781, in consequence of the destruction, by fire, of a frigate in the harbour of Cronstadt; the conflagration of a large hemp magazine, in the same place in the same year; and a slight fire on board another frigate, in the same port, in the following year.

These accidents led to a very strict examination of the subject by the Russian government; when it came out, that at the time of the second accident, several parcels of matting tied with pack-thread, in which the soot of burnt fir-wood had been mixed with oil for painting the ship, had been lying some time on the floor of the cabin, whence the fire broke out. In consequence of this important discovery, forty pounds of fir-wood soot were well soaked in about thirty-five pounds of hemp oil varnish, and the whole was wrapped up in a mat, and put in a close cabin. In about sixteen hours, it was observed to give out a smoke, which rapidly increased and when the door was opened, and the air freely admitted, the whole burst into a flame. Three pounds of fir-black were mixed with five pounds of hemp-oil varnish, and the whole bound up in linen, and shut up in a chest. In sixteen hours, it emitted a very nauseous putrid smell and steam; and two hours afterwards, it was actually on fire, and burnt to ashes.

In another experiment, the same occurrences took place, but not till the end of forty-one hours after the mixture had been made; and in these and many similar experiments, they all succeeded better, and kindled sooner, in dry, than in rainy weather. Chimney soot used, instead of lamp-black did not answer, nor was any effect produced, when oil of turpentine was substituted for the hemp or rape-oil.

In general it was found, that the combination took place more readily with the coarser and more unctuous bit-black, than with the finer sorts; but the proportions of the black to the oil did not appear to be of any great moment. Sometimes, in wet weather, these mixtures only became hot for some hours, and then cooled again, without actually taking fire.

In all these cases, the soot or black, was from wood, and not coal. The presence of lamp-black, or any other dry carbonaceous matter, is not necessary however; for, spontaneous inflammation will take place in hemp or cotton, simply soaked in any of these expressed oils, when in considerable quantity, or under circumstances favorable to this process; as in hot weather, or when closely shut up. An accident of this sort happened at Gainsborough, in Lincolnshire, in July, 1794, with a bale of yarn 120 lb., accidentally soaked in rape oil; which, after remaining in a warehouse for several days, began to smoke, to emit a most nauseous smell, and finally to burst out into a most violent flame. A similar accident, with a small quantity of the same materials, happened at Bombay. A bottle of linseed oil had been left standing on a chest. This had been thrown down by accident in the night. The oil ran into the chest which contained some coarse cotton cloth, and in the morning the cloth was found scorching hot, and reduced nearly to tinder, the wood of the chest also was charred on the inside. On subsequent trial, a piece of the same cloth was soaked in oil, shut up in a box, and in no longer time than three hours, it was found scorching hot; and on opening the cloth it burst into flame.

Similar to this is the spontaneous combustion of wool, or woollen yarn, which has occasionally happened when large quantities have been kept heaped up in rooms little aired, and in hot weather. The oil with which wool is dressed, which is generally rape-oil, appears the chief agent in this combustion. Even high dried, oily, or fatty matter, of any kind, will alone take fire, when placed in circumstances very favorable to this process. Rye flour roasted till half parched, and of the color of coffee, and wrapped up in a linen cloth, has been found to heat violently, and to destroy the cloth. Wheat flour when heated in large quantities, and highly dried, has been known to take fire in hot weather, causing accidents in granaries and bakers' shops. An accident of this kind is related by Count Morozz, in the Memoirs of the Turin Academy, to have happened at a flour warehouse at Turin, containing about three hundred sacks of flour. It began by a violent explosion, on a lamp being brought into the warehouse, and the whole was soon after in flames. Charcoal alone also has been known to take fire in powder mills, when quantities of it in powder have been kept for some time closely packed.

Another, and totally different species of spontaneous combustion, is that which occurs during the oxygenation or acidification of pyrites, or sulphurets of iron, copper, &c.

A most singular, and if not well authenticated, a scarcely credible species of spontaneous inflammation, is that in a few rare instances, known to occur in the human body. It is not quite certain indeed, whether the first inflammation has been quite spontaneous, or caused by the approach of a heated substance; but in these melancholy accidents, the body of the sufferer has been brought to a state of such high combustibility, that

the flame once kindled, has gone on without other fuel, to the entire destruction of every part, (the bones and extremities excepted) and as it appears, has been attended with actual flame, of a lambent faint light. This change is the more remarkable, as the human body, in all its usual states, both of health and disease is scarcely at all of itself combustible, and cannot be reduced to ashes without the assistance of a very large pile of faggots, or other fuel; as universal experience, in the very ancient mode of sepulture, and the history of martyrdoms, abundantly shows. Cases of this human combustion on record have occurred in different countries. Two of them, well authenticated, are recorded in the Philosophical Transactions, and occurred in England; and a few others in Italy, France, and elsewhere. In all but one, the subjects of them have been females rather advanced in life, of indolent habits, and apparently much addicted to spirituous liquors.

The accident has generally been detected by the penetrating fetid smell of burning and sooty films, which have spread to a great distance; and the sufferers have in every instance been discovered dead, and with the body more or less completely burnt up, leaving in the burnt parts only an oily, crumbly, sooty, and extremely fetid matter. Another circumstance in which these cases all agree, is the comparative weakness of the heat produced by this combustion, notwithstanding the very complete disorganization of the body itself, so that the furniture of the room, wooden chairs, &c. found within the reach of the burning body, were in many instances absolutely unhurt, and in others only scorched; the heat not having been strong enough to set them on fire. It is impossible to give an adequate reason for this remarkable change; nor does it seem before the very time of the accident to have produced any very sensible alteration in the appearance and functions of the body, which is certainly a most astonishing circumstance. With regard to the effect which the use of ardent spirits is supposed to have in this case, it is impossible not to imagine that this cause may contribute largely to such a change; but the instances of the abuse of spirits are so innumerable, and those of this surprising combustion are so extremely rare, that very little satisfaction can be obtained from this explanation.

Hydrogen gas enters largely into all animal, vegetable, and many mineral compositions. Hence, it is frequently set at liberty by fermentation or spontaneous decomposition in bogs and marshes; when from electricity or some other accidental cause, it is often set on fire. This phenomenon has been observed in almost all parts of the world. In Persia it is converted into a *pious fraud* by the priesthood, who by means of hollowed reeds, convey the carbonated hydrogen gas into one of their temples, which has been purposely built upon ground abounding in bitumen, naphtha, and other inflammable substances. As the Persians have always been worshippers of fire, the imposture is a happy one, for in this temple, they are continually seated with a view of their Deity.

At Bland, near Northampton, in the forenoon of September 11th, 1810, a fire broke out in an ash-pit. Mr. Marsh, the proprietor, immediately went in the spot with some friends, and found the fire burning from the earth in many places, and in a short time it would have communicated to a great cover, had it not been for the timely assistance of several persons, who had been brought to assist.

ness this extraordinary phenomenon. As there was some lightning during the morning, it was imagined a fire-ball had been the cause, but it was generally supposed to be occasioned by the excessive dryness of the ground, which had been a bog, recently drained for planting; and that the extreme heat of the sun had caused it to ignite.

WINE FROM UNRIPE GOOSEBERRIES.

The following process is taken from Dr. Macculloch, whose labors are well known and duly appreciated:—

The fruit must be selected before it has shown the least tendency to ripen, but about the time when it has nearly attained its full growth. The particular variety of gooseberry is perhaps indifferent, but it will be advisable to avoid the use of those which in their ripe state have the highest flavor. The *green Bath* is, perhaps, amongst the best. The smallest should be separated by a sieve properly adapted to this purpose; and any unsound or bruised fruit rejected, while the remains of the blossom and the fruit-stalk should be removed by friction or otherwise. Forty pounds of such fruit are then to be introduced into a tub carefully cleaned, and of the capacity of fifteen or twenty gallons, in which it is to be bruised in successive quantities by a pressure sufficient to burst the berries without breaking the seeds, or materially compressing the skins. Four gallons of water are then to be poured into the vessel, and the contents are to be carefully stirred and squeezed in the hand until the whole of the juice and pulp are separated from the solid matters. The materials are then to remain at rest from six to twenty-four hours, when they are to be strained through a coarse bag, by as much force as can be conveniently applied to them. One gallon of fresh water may afterwards be passed through the *marc*, for the purpose of removing any soluble matter which may have remained behind. Thirty pounds of white sugar are now to be dissolved in the juice thus procured, and the total bulk of the fluid made up with water to the amount of ten gallons and a half.

The liquor thus obtained is the artificial must, which is equivalent to the juice of the grape. It is now to be introduced into a tub of sufficient capacity, over which a blanket covered by a board is to be thrown, the vessel being placed in a temperature varying from 55° to 60° of the thermometer. Here it may remain for twenty-four hours or two days, according to the symptoms of fermentation which it may show; and from this tub it is to be drawn off into the cask in which it is to ferment. When in the cask, it must be filled nearly to the bung-hole, that the scum which arises may be thrown out. As the fermentation proceeds, and the bulk of the liquor in the cask diminishes, the superfluous portion of must, which was made for this express purpose, must be poured in, so as to keep the liquor still near the bung-hole. When the fermentation becomes a little more languid, as may be known by a diminution of the hissing noise, the bung is to be driven in, and a hole bored by a gimlet, into which a wooden peg is to be fitted. After a few days this peg is to be loosened, that, if any material quantity of air has been generated, it may have vent. The same operation is to be made after successive intervals; and when there appears no longer any danger of excessive expansion, the plug may be permanently tightened. The wine thus made must remain during the winter in a cool cellar, as it is no longer necessary

to provoke the fermenting process. If the operator is not inclined to bestow any further labor or expense on it, it may be examined in some clear and cold day towards the end of February or beginning of March, when, if fine, as it will sometimes be, it may be bottled without further precautions.

To ensure its fineness, however, it is a better practice to decant it towards the end of December into a fresh cask, so as to clear it from its first lees. At this time, also, the operator will be able to determine whether it is not too sweet for his views. In this case, instead of decanting it, he will stir up the lees so as to renew the fermenting process, taking care also to increase the temperature at the same time. At whatever time the wine has been decanted, it is to be fined in the usual way with isinglass. Sometimes it is found expedient to decant it a second time into a fresh cask, and again to repeat the operation of fining. All these removals should be made in clear, dry, and if possible, cold weather. In any case it must be bottled during the month of March. The wine thus produced will generally be brisk; and singular in its qualities (flavor excepted) to the wines of Champagne, with the strength of the best Sillery. Inattention, or circumstances which cannot always be controlled, will sometimes cause it to be sweet and still, and sometimes dry.

In the former case it may be remanufactured the following season, by adding to it that proportion of juice from fresh fruit which the operator's judgment may dictate, and renewing the fermentation and subsequent treatment as before. If the latter case, as its briskness can never be restored, it must be treated as a dry wine, by decanting into a sulphured cask, when it must be fined and bottled in the usual manner. Such dry wines are occasionally disagreeable to the taste in the first or second year, but are much improved by keeping.

If the whole *marc* be allowed to remain in the juice during the first fermentation, the process will be more rapid, the wine stronger and less sweet; but it will acquire more flavor. If the wine is intended to be very sweet as well as brisk, the quantity of sugar may be increased to forty pounds; if less sweet and less strong, the sugar may be reduced to twenty-five pounds; it will then be brisk, but less durable, and ought to be consumed within a year. When the quantity of sugar is thirty pounds, it will be, perhaps, better to use fifty pounds of fruit than forty, as generally recommended.

In this process it may be observed that no brandy is added to the wine after it is finished, although it is the invariable practice amongst makers of domestic wine to add it. Dr. Macculloch says that this practice has been introduced under the mistaken notion of preventing wine from turning sour, and enabling them to keep a longer time. But he says that this admixture decomposes wine, and that, although slow, the process is certain. The first and most conspicuous effect is the loss of that undefinable lively or brisk flavor, which all those who possess accuracy of taste can discover in French wines, or in natural wines. Brandy is not added to wines in France or Germany; the finer wines, claret, Burgundy, and hock, are totally destroyed by it. But the practice is universal in the wines of Spain, Portugal, and Sicily, which are intended for the English market. They are at first rough and strong; but kept long enough in the cask they at length ameliorate; their elements combine intimately, and their aroma is developed.

CORAL.

THE notions which are commonly entertained on the subject of zoophytes, and their mode of organization and growth, are extremely inaccurate and erroneous. Persons speak of coral insects building their cells, as if these erections were constructed in the same manner as the bee erects her edifice of wax, constituting places of abode in the animal itself. The fact is, that the substance usually termed the coral is the support of the fleshy, or gelatinous substance which constitutes the animal portion, affording pores in which the polypi reside, and from which they protrude for the purpose of obtaining food by preying on the animalculæ existing in the waters. The coral is in fact the skeleton of the creature, fulfilling the same office as the bones of our frame, secreted and formed in the same manner; varied in form, and in the case of the stony corals, from the same elementary substance—lime. Occasionally the axis or support is of the nature of wood, occasionally of horn, resembling the nails in the human frame; while the form is alike diversified, and is flexible, bending, jointed, or articulated. The essential conditions, however, remain in all instances the same; and we universally observe a skeleton or solid support, and a fleshy or jelly-like covering, the abode of polypi and small worms. The smaller and less important varieties abound in the British ocean and other seas of Europe; becoming more frequent and abundant in the Mediterranean, and increasing in proportion as we approach towards the south. The large stony corals are chiefly restricted to the vicinity of the equator, and within thirty degrees north and south of the line they exist in such numbers and extent, as to modify, to a very considerable degree, the physical geography of those regions. The history of their operations is briefly this:—The animal substance, after a due period of existence, dies and passes away, but leaves its stony base or skeleton behind. During life, however, it gives birth to creatures of like nature with itself, which, accumulating on the stony mass, leave behind in turn their calcareous skeleton; and the process goes on, until, by successive accumulations of this nature, coral reefs are formed, which, rising above the water, constitute new islands and fresh abodes for the use of man. Some of the largest islands in the Southern Pacific Ocean are no more than coral reefs; and so extensive and incessant are the operations of this apparently trivial creature, as to constitute one of the most powerful agencies in the circle of geological phenomena. The investigation into the early formations show that creatures of the same class have been in active operation from the earliest periods of the physical history of our earth; and we find that the hills of Devon and the mountains of Derbyshire are, for the most part, only fossil reefs of coral—the operation of animalculæ similar to those now employed in constructing the reefs and islands of the southern hemisphere, and in modifying the geography of those regions, as they have already changed that of our own island.

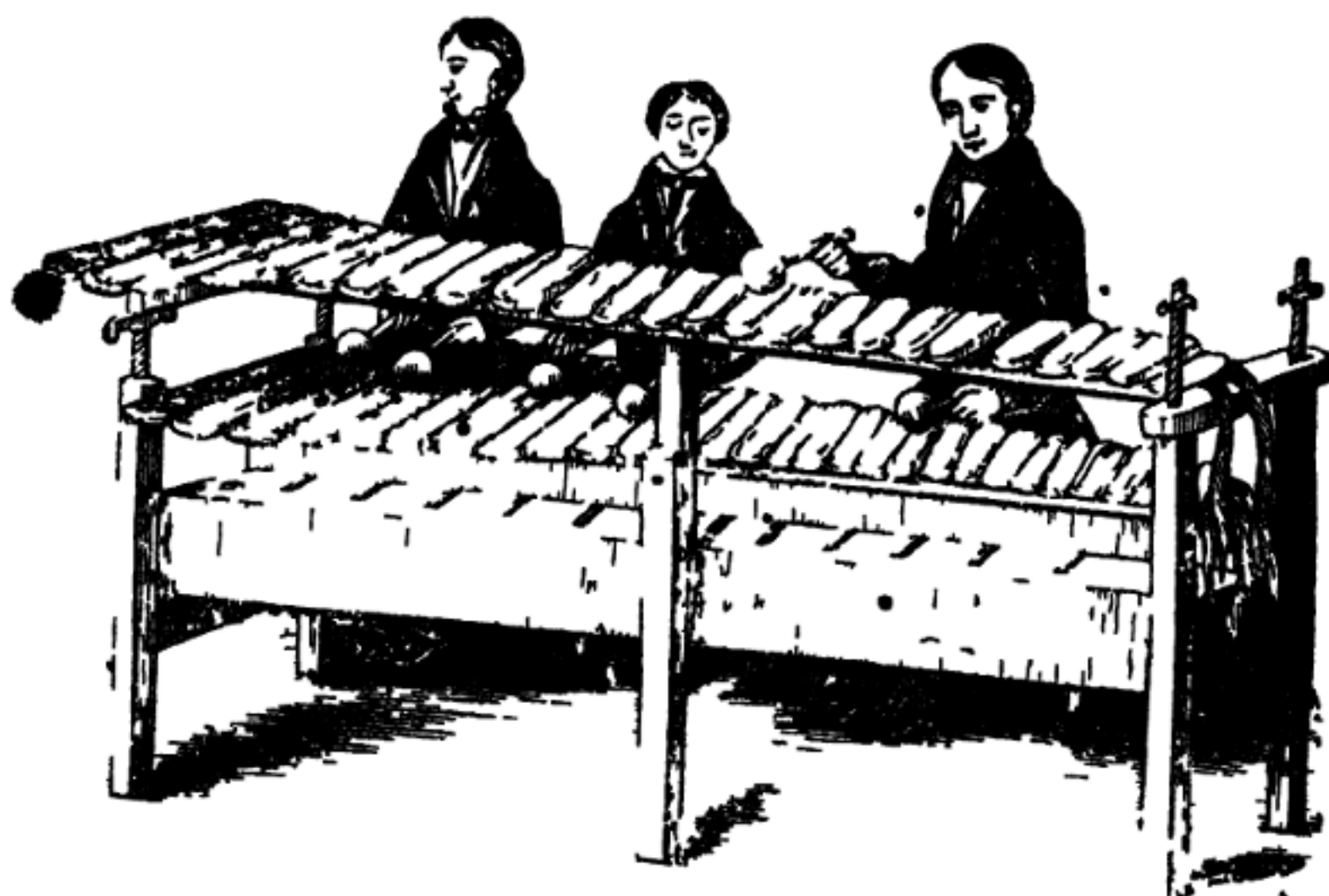
REMOVING GREASE FROM BOOKS.

A TASTE for elegant editions, books in good preservation, and proof impressions of prints, can be considered as a mania only by those who are unacquainted with literature. In a well printed, carefully preserved and neat book, the sense seems to pass through the organs of sight; in order to meet

the understanding; while in a bad, confused edition, or a dirty, stained, and disgusting copy, the confusion of the characters deranges, as it were, the connexion of the author's thoughts; their obscurity divests ideas of their brilliancy; and the dirtiness of the paper, which offends the eye, makes the subject lose much of its charms and attraction. The following process, for removing such blemishes, is efficacious:—Discharge as much as possible of the grease, or oil, by placing the stained paper between some folds of blotting paper, and applying a moderately hot smoothing-iron; or rubbing over it the bowl of a heated iron spoon. Then dip a small brush in the essential oil of well rectified spirit of turpentine, heated almost to ebullition, (for when cold it acts only very weakly,) and draw it gently over both sides of the paper, which must be carefully kept warm. This operation must be repeated as many times as the quantity of the fat body imbibed by the paper, or the thickness of the paper, may render necessary. When the greasy substance is entirely removed, recourse may be had to the following method to restore the paper to its former whiteness, which is not completely restored by the first process. Dip another brush in highly rectified spirit of wine, and draw it in like manner, over the place which was stained, and particularly round the edges, to remove the border, that would still present a stain. By employing these means, with proper caution, the spot will totally disappear; the paper will resume its original whiteness; and if the process has been employed on a part written on with common ink, or printed with printer's ink, it will experience no alteration.

CATERPILLAR WEAVERS.

A NUMBER of years ago, M. Habenstreet, of Munich, an old officer, amused himself by directing the labor of caterpillars, and succeeded in producing an entirely new and curious fabric. These caterpillars are the larvæ of a butterfly known by the name of *finca punctata*. Their instinct leads them to construct above themselves a covering of extreme fineness; but, nevertheless, firm enough to be impenetrable by air, which covering can be easily detached from them. The inventor made these insects work on a suspended paper model, to which he gave exactly the form and size which he required. He thus obtained, at pleasure, among other articles, square shawls, of the dimensions of an ell; shawls, two ells in length and one in width; an aerostatic balloon, four feet high by two in horizontal diameter; a lady's entire dress, with sleeves, but without seam. When he wished to give to the fabric any prescribed shape, all that he found necessary was to touch the limits which ought not to be passed with oil, for which the caterpillars have natural repugnance so strong that they will not come in contact with it. The fabric, although perfectly consistent, surpassed the finest cambric in lightness. The balloon which we have mentioned weighed less than five grains. The warmth of the hand was sufficient instantly to inflate it; and the flame of a single match, held under it for a few seconds, was enough to raise it for a considerable height, whence it would not descend for half an hour. When a shawl the size of a square ell had been well stretched, it was blown into the air by means of a small pair of bellows, and then resembled a light smoke.—*Boston Mercantile Journal*.



THE LOCK HARMONICON



THE CENTRIFUGAL RAILWAY

THE ROCK HARMONICON.

It is pleasing to contemplate the results of intellectual effort when made amidst all the advantages that can be commanded: but it is especially so to mark its patient and persevering struggles to accomplish some favorite object, when it can only do so alone and unsustained. An instance of this kind is found in the invention before us—Joseph Richardson, a plain unassuming man, with no refinements of education, but possessed of musical talent, while working as a mason in Cumberland, discovered that various and melodious sounds were extracted from the rocks amongst which he was accustomed to pursue his daily labors. It then occurred to him that fragments might be collected, and so judiciously arranged, as to form a musical instrument of surpassing sweetness and power. In the year 1827, being employed in building a house at Thornthwaite, and afterwards another at Braithwaite, in the vicinity of Keswick, he began to collect stones for its construction. Those he thus obtained, however, did not answer his purpose, so that at the outset of his undertaking he lost a large portion of time and labor, and suffered disappointment enough to discourage an ordinary mind.

But stimulated by failure to continue his research and toil he found that the stones best calculated for his design were only to be met with amongst the rocks of Skiddaw, and on these he expended his future exertions. Animated now by the hope of success he bore these masses from the mountain on his back to his home at a considerable distance, and there proceeded to reduce them to the shape he considered necessary, and to put to the test their varied tones. This involved an amount of effort not easily estimated: it was made after many a hard day's work in the mountains; and often did Richardson deny himself the repose he required, and pass whole nights after his family had retired to rest, pursuing the object on which his heart was set. A considerable share of disappointment must still have been his lot; the stone which promised well would not answer the purpose if hammered and chiselled beyond a certain point; and it may be supposed there were times in which his heart failed him, particularly as a family of eight children were dependent on his daily labor for support, and his task was continued amidst much weariness and trial. At length, however, his skill and perseverance were rewarded, and after more than thirteen years incessant labor, he succeeded in constructing a musical instrument of a very extraordinary character, which is properly called "The Rock Harmonicon." It consists of rough stones, the longest of which is about four feet six inches in length, about three inches in breadth, and about an inch and a half in thickness; and the shortest of which is about six inches in length, an inch in breadth, and half an inch in thickness: these are placed across a pair of wooden bars, covered with twisted straw, and form the keys, like those of a piano-forte; the material of them all being the mica schist, or as it is commonly called, in Cumberland and other places, whinstone. The means employed to extract their sounds are wooden hammers; small, and of lignum-vitæ, for the treble; larger, and of elm or ash, for the middle notes; and larger still, and covered with leather, for the bass. Sometimes for the centre keys, hammers are used with two knobs on each, in the form of a crutch-handle, to strike thirds. Those who are acquainted with the toy harmonicon,

consisting of pieces of glass laid on tapes, to be struck with a cork hammer, will readily form an idea of this singular instrument, and the mode in which its sounds are elicited.

The pieces of stone, it should be remarked, are arranged in two rows; the lower one being tuned in the diatonic scale, and the upper one containing the flats and sharps. A piece of music may therefore be played in any key, with the greatest facility and fidelity. Three sons of the inventor perform on the instrument pieces of music in three distinct parts; one playing the melody, the next executing a clever working inner part, and the third the fundamental bass. Its power extends to a compass of five octaves and a half, accompanied by all the semitones, tuned from F below the bass staff to C in altissimo—extending, in fact, as high as the warble of the lark, down to the deep bass of a funeral bell. The tones produced are equal in quality, and sometimes superior in mellowness and fulness, to those of a fine piano-forte, under the hand of a skilful player. Difficult chromatic ascents and descents are performed with a truly extraordinary brilliancy and crispness. A professor of music at Liverpool produced, in conjunction with the sons of the inventor, and also alone, some very pleasing and striking effects. M. Costa, addressing the inventor, says, "I have been very much gratified with the performance of your three sons on your very ingenious instrument, and sincerely wish you may be recompensed for your wonderful discovery." Sir G. Smart also writes, "I am happy to offer my testimony in favor of your very clever invention, and think the production of the 'Rock Harmonicon' does infinite credit to your perseverance and musical feeling; the tones of the instrument are powerful and beautiful, and I was highly pleased with the performance of your three sons upon it. I sincerely hope your labors will be rewarded as they richly deserve."

THE CENTRIFUGAL RAILWAY.

THERE is now exhibiting at the Egyptian Hall, London, a railway, which has properly been called a centrifugal railway, and on which persons are daily in the habit of being propelled, descending on the one side with immense rapidity, then travelling round a vertical circle of iron, and afterwards ascending to a place of safety at the opposite end of the apartment. It certainly appears awful thus to see persons travelling head downwards, when we know that there is nothing whatever to hold and retain in its inverted position the carriage in which they are thus placed; yet science teaches, and daily experience proves, that no real danger is to be apprehended, as the momentum acquired by the carriage in its descent is sufficient to direct it safely on its course.

We have, during the whole progress of this Magazine, been especially solicitous never to introduce the same article twice, that ever-changing variety may characterize our pages, but for once we find it necessary to depart from this rule, for the sake of those who may not have our early numbers. Those who have will find that we described this very railway more than three years ago, in a review of Professor Mosley's "Illustrations of Mechanics," page 63 of our first volume. The extract there given, explanatory of this subject, is as follows, and the illustration is also shown in one of the present cuts—it being modified and improved according to the arrangement at the Egyptian Hall. The principle, however, as will be evident, remains the same.

To make a carriage run in an inverted position without falling.—Let a bar of iron be turned round, so as to form a circle, the two ends being brought out into two inclined planes, and the two curved portions of the bar being made to lie a small distance apart at the point where they pass each other. This bar being now placed with the curved portion of it in a vertical position, let a small heavy carriage be placed at one of its extremities with wheels, on the outside of which are flanges, to keep it as it rolls upon the bar. Descending the inclined plane, this carriage will ascend the curve, and if the point from which it has descended be high enough, the velocity it will have acquired will cause it to ascend to the top of the curve, and give to it sufficient centrifugal force at that point to overcome its gravity, and cause it to run on in that inverted position without falling. It will thus descend in safety on the opposite branch of the curve, and will again be brought to rest as it ascends the opposite inclined plane towards the other extremity of the bar. This ingenious illustration of the effect of centrifugal force was devised by Mr. Roberts, of Manchester.

A RAMBLE AMONG THE PLANETS.

WERE we in the planet Mercury the solar spots would appear seven times larger to us than they do here; the sun would rise and set with an unimaginable splendour; while by night Venus, the earth, and its "fair attendant" satellite, would exhibit themselves, each many times larger than Mercury does to us. The moon, too, would be often seen to transit the earth; and, every now and then, to glide into and emerge from its shadow.

Were we transplanted to Venus, Mercury would present to our eyes phenomena similar to those which Venus presents here—sometimes full, sometimes gibbous; at other times a crescent; now a morning star, and now an evening one: while the earth and moon would shed a light more brilliant than that which is communicated or received by night by any other planet of the solar system.

To the inhabitants of Mars, Venus and the earth appear, in most respects, as Mercury and Venus appear to us; exhibiting similar phases, with this exception—they never present themselves in full. Sometimes our moon is seen by them on one side of the earth, sometimes on the other. Sometimes they are observed to pass over the disc of the sun, in the shape of two unequal black spots, at no greater distance from each other than one-third of a degree. The fixed stars are beheld much as we behold them: while the Asteroids, with Jupiter, Saturn, and Uranus, present surfaces somewhat larger than they do to us.

The Asteroids are supposed by some to have been originally formed out of one large planet. They have, more probably, existed from the creation and adjustment of the system, as well as Jupiter and other planets. All these planets enjoy a view of each other: also of the earth (but not of the moon,) and Mars, Jupiter, Saturn, and Uranus; all their satellites; and the stupendous rings of Saturn. This is not all. Their diameters are so small, that every star of their firmament, from pole to pole, may be seen by the mere travel of a few hours. Their diameters have been thus estimated:—Juno, 1,425 miles; Vesta, 238; Ceres, 163; Pallas, 80. The diameters of their three external neighbours,

however, are—Uranus, 35,112 miles; Saturn, 79,042; and Jupiter, 89,170. What stupendous disproportions!

Now let us suppose ourselves on the surface of Jupiter. The stars rise to our vision; and, in course of three or four hours, set. They move, as it were, not in a gradual course, as with us; but with a precipitation that would dazzle our eyes and bewilder our senses: for the entire heavens appear to the inhabitants in a state of almost mercurial activity. The day, however, is not so splendid as ours; being so much farther from the sun. The eclipses on Jupiter are of three kinds:—solar, lunar, and satellital: and the tints of the satellites have an extremely beautiful effect; for two are white; a third blue; and the fourth orange: and, when all of them are above the horizon, the shadows of objects are cast in four different directions.

Transport ourselves now to the first satellite of Jupiter. What a scene presents itself! Three moons rise, instead of one, as with us:—with all their diversified phases; one a crescent; one gibbous; one at the full!—and the nearest with twice the diameter of our moon to us; while Jupiter himself hangs like a huge ball, turning rapidly on his axis, now rising, now waxing, now waning; now a crescent, and now a full and ample shield, as it were, covering a vast space of the firmament; and all this in the short space of forty-two hours and a half. Having, it is presumed, no atmosphere, the heavens present a field as black as ebony; and each star shines with a brilliancy more intense than that arising from the concentration of ten thousand diamonds. In 1770 a comet swept through these satellites, without, in the smallest degree, deranging their motions. The Biela and Encke comets, too, ranging through the solar system, between Jupiter and the earth, their aphelion and perihelion are equally harmless.

Saturn, when beheld from our globe with his attendants through a telescope, appears to occupy a space of the heavens not larger than a Spanish dollar. Instead of one moon he has seven, all presenting varied appearances, and casting seven shadows upon his surface. Sometimes they are beheld eclipsing each other, or appearing, disappearing, and reappearing from between and behind two stupendous rings that surround his orb, and which frequently eclipse a great part of it; and those eclipses varying from a minute to the whole length of a day; and coming on with a suddenness that would appal the mind, did not their frequency take from the wonder. "The day of Saturn, too, occupying only a little more than ten of our hours, the whole phenomena of the firmament above him pass with a rapidity more than double that presented in our own hemispheres." The rings, too, sometimes cast shadows upon him; and sometimes shine with even greater splendour than the planet itself. Above, below, and between these vast arches, if we may so call them, the stars are seen; and, possibly, many planets of which we have no knowledge. These rings are not perceptible at the poles of Saturn—nor within several degrees of them; but where they are visible, nothing that we know in nature presents so noble, or so wonderful, and astonishing an appearance; illuminating the night with a splendour more than equal to that of several thousand moons like ours. Indeed, Saturn knows no darkness, except when these rings eclipse the sun.

Pass, now, into the regions of Uranus. The sun appears of a size not larger than Venus. Six

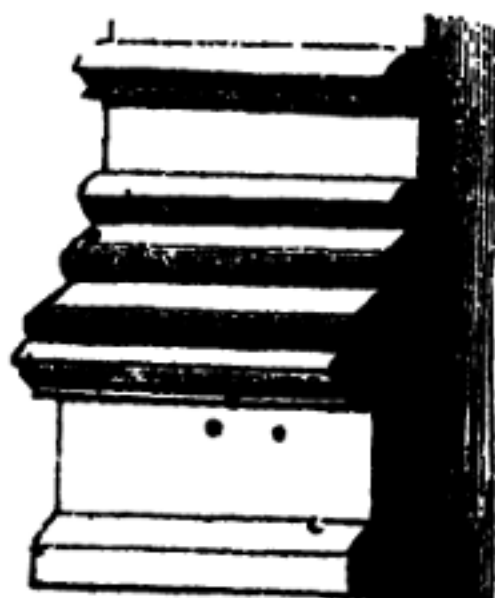
satellites, however, rise in his horizon; and what is still more wonderful they are observed to move in orbits perpendicular to the plane of the ecliptic, and in a direction contrary to that of all other secondaries, as well as primaries; indicating perhaps, an approach, if not an actual beginning, of another province of the solar empire. Uranus, however, sees only one of the planets that we behold—Saturn. To make up for this, his inhabitants, doubtless, see many other worlds beyond their own orbit, which we from distance are unable to behold.

Now, let us suppose ourselves upon the surface of a comet. If comets are self-luminous, we shall see nothing beyond our own globe; our eyes being partly blinded with excess of light. If, however, they are dark spheres, illuminated by other bodies, we for ages behold nebulae, systems of stars, suns, and comets, unseen by mortal eyes. We enter, at length, the solar regions. We behold Uranus and his satellites moving in a course contrary to all other analogies; we pass the empire of Saturn, encircled by his seven moons and double ring: we come within the orbit of Jupiter and his four companions; we pass the Asteroids, and gaze with delight on their diminutive masses, as we had before with amazement on the immensity of others. We invade the orbit of the earth—we dart through it to those of Venus and Mercury; and then, navigating the more immediate regions of the sun, we pass over on the other side, and commence our return to our secret aphelium in the bosom of space.

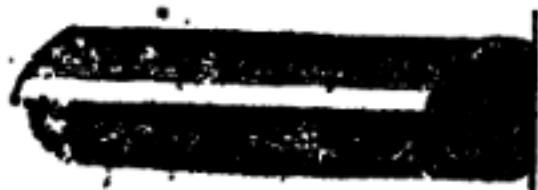
ARCHITECTURAL MOULDINGS AND ORNAMENTS.

(Resumed from page 133, and concluded.)

In the decorated style, the mouldings no longer consist of equal rounds with hollows as in the Early English, but an assemblage of various members, some broad and some narrow, beautifully grouped and proportioned. The following base moulding from Leadenham Church, built about 1330, will show their general character.



Among mouldings of this age one is often found consisting of a roll, with an edge as it were overlapping, resembling a roll of stiff paper with the edge uppermost, as in Chacombe Church, Northamptonshire.



This roll moulding is often used with a hollow under it. The quarter round is also frequently used in this style, so also is the filleted round.



In general the mouldings are less bold, more numerous, and more clustered together than in the Early English. The style of ornament is also very different and more original, especially remembering that the trefoil, quatrefoil, and others of a similar character, were now introduced.



Rose Ornament.—Iffley Church, Oxfordshire.



Trefoil.—Little Maplested Church, Essex.



Quatrefoil.—Little Maplested Church, Essex.

Clustered columns were now common, though a few examples occur of a former period, but less graceful, than those of the decorated style. The foliage introduced, especially in the capitals, was infinitely more beautiful.—Witness the following example from York Cathedral.



Perpendicular style.—This term includes the florid, or Tudor style of Gothic, which forms the later division of it. The windows afford the most striking character of this style; and the eye at once distinguishes it from any other, by observing that the mullions are continued through the head of the window, and that perpendicular lines prevail throughout all the tracery. The windows in the early and better part of this style are large and lofty, divided by horizontal transoms into two or three parts. They soon became more broad, less lofty, the arch more and more depressed, until the square-headed window prevailed almost universally. The four-centered arch is generally characteristic of this style, and in the latter period of it almost universal, but not invariable; as amongst the ornamental parts of niches,

&c. arches of almost every form may be found: an ogee arch is not unfrequently used in late perpendicular work, but principally for the heads of small doorways, &c.—The doorways of this style have usually a square head over the arch, and the spandril generally filled with some ornament: in the



interior an ogee canopy is sometimes used, instead of the square head; or the panelling, which forms one of the most striking marks of this style, is continued quite to the arch. The whole surface of the walls, both within and without, is sometimes covered with panelling which produces a rich and exuberant, but somewhat frittered and tawdry effect. Domical roofs to the turrets are also characteristic of this style, as at King's College Chapel. Another ornament peculiar to this style is the figure of an angel with expanded wings supporting a shield, or as a corbel, or a row of them in a cornice: the rose and portcullis of Henry the Seventh also very frequently occur: the ornament called the Tudor-flower, resembling an oak or strawberry leaf, is also frequently found as a finish to the cornice of rich screen-work, or over niches, &c. as in St. Mary's, Oxford.



The perpendicular style commenced in the latter part of the fourteenth century, prevailed throughout the fifteenth, and in the early part of the sixteenth.

PERPETUAL LAMPS.

BEFORE the improved state of philosophy had shown the impossibility of real unextinguishable fire, the learned were much divided in their opinions on this subject; but of all the champions in favor of perpetual lamps, none has made greater efforts to obtain credit to their existence than Fortunio Liceti, in his book entitled "*De Reconditis Antiquorum Lucernis*." If credit may be given to this author, nothing was more common among the ancients than perpetual lamps. The lamp of Demosthenes, that which burnt in the temple of Minerva at Athens, the Vestal fire at Rome, all furnish him with so many proofs of the possibility of unextinguishable fire. We cannot help smiling to see so much learning so idly employed; for who does not know that these fires were called perpetual, merely because it was a point of religion to preserve them from being extinguished, and to supply them with continual aliment? The other partisans of perpetual lamps, while they smile at the simplicity of Liceti, support their reasoning on facts, which seem to carry with them a little more weight. They are as follow:—

1. *The Lamp of Tulliola.*—The tomb of Tulliola, the beloved daughter of Cicero, and whose death

cost him so many tears, was discovered, it is said, under the pontificate of Pius III. It is pretended that in this tomb there was a lamp actually burning, but which became extinguished on the admission of air.

2. *The Lamp of Olybius.*—But it is the lamp of Olybius, which, above all others, supplies the partisans of perpetual lamps with one of their strongest arguments. In the year 1500, as we are told, some peasants, digging the earth to a considerable depth at Atesta, in the neighbourhood of Padua, came to a tomb, in which they found two earthen urns, one within the other. The inner, it is said, contained a burning lamp, placed between two phials; one filled with liquid gold, and the other with liquid silver. Such is the manner in which this curious discovery is related by Gesner. But what follows is still stronger. Liceti gives a letter of one Maturantius, who told his friend Alphenus, that he had got possession of this valuable treasure. "Both the vases," says he, "with the inscriptions, the lamp, and the phials, have fallen into my hands, and are now in my possession. If you saw them you would be astonished, I would not part with them for a thousand crowns of gold." This is no doubt the language of a man who believes he possesses an inestimable rarity. We do not however know that it exists in any collection. It appears that in this case, as in regard to the tomb of Tulliola, an accident prevented enlightened people from being witnesses to the phenomenon; for we read in the credulous Porta, that as the peasants who found this treasure handled it too roughly the lamp broke in their hands, and was extinguished.

3. *The Lamp of Pallas, the son of Evander.*—We are told also that, about the year 800 of the Christian era, the tomb of the famous Pallas, the son of Evander, killed as is well known by Turnus, was found at Rome. It was known to be that of Pallas by these verses:—

"*Filius Evandri Pallas, quem lancea Turni
Militis occidit, more suo jacet hic.*"

It contained a burning lamp, which consequently must have burnt nearly 2000 years, since it was shut up in the year 1170 before the Christian era.

4. *The Lamp in the Temple of Venus.*—This lamp, and the temple of Venus, in which it was suspended, are mentioned by St. Augustine. He says it burnt perpetually, and that the flame adhered so strongly to the combustible matter, that neither wind, rain, nor tempests could extinguish it, though continually exposed to the air, and to the inclemency of the seasons. This author endeavours to explain the mechanism of it, and after offering a conjecture, which in part is pretty correct, namely, that a wick of asbestos was perhaps employed; he concludes by saying, that it might have been the work of demons, in order to blind the pagans more and more, and to attach them to the infamous deity worshipped in this temple. Here then, according to the partisans of perpetual lamps, we have unextinguishable fire, the existence of which is fully confirmed by the testimony of the most enlightened man of his age; and who, notwithstanding his knowledge, is obliged to have recourse to the artifices of demons to explain this phenomenon.

5. *Lamps of Cassiodorus.*—The celebrated Cassiodorus, who, it is well known, was as much respected on account of his employments as of his talents, tells us himself that he made perpetual

lamps for his monastery at Viviers. Each monk, it is probable, had one of them for his own use.

Such are the principal facts adduced in favor of perpetual lamps; but we may venture to say that they will not stand the test of critical examination. In regard to the first three, what dependence can be placed on facts related in so vague a manner, and accompanied with such incoherent and romantic circumstances? None of these facts are supported by any other testimony than that of men who lived a long time after; no person whose testimony is of any weight asserts that he actually saw them. But in disputes which are contrary to the common laws of nature, they must at least be certified by enlightened men, above all suspicion of credulity or ignorance.

The tale respecting the tomb of Tulliola is as old as the year 1345, a period when all Europe was sunk in the grossest ignorance. A body is said to have been found in it, and in that case it could not be the body of Tulliola; for the Romans, in the time of Cicero, always burnt their dead. In consequence of this, and similar circumstances, some authors have conjectured that the tomb alluded to was that of the wife of Stilico; but the Christians never placed lamps in their tombs. The account therefore of a lamp found in this tomb has every appearance of a fiction. But what shall we say of the tomb of Olybius, and the lamp with two phials, one filled with fluid gold, and the other with fluid silver? This double urn was found by peasants, who according to some authors handled the lamp, contained in the second urn, so clumsily as to break it; and yet Maturantius pretends that he had it in his possession. Who saw the lamp burning? What evidence have we that the peasants beheld it in that state? And whose testimony in this case would be admissible? Some vapour, exhaled from a place shut up for so many ages, might easily impose on rude and ignorant people. The story of the tomb of Pallas, the son of Evander, is scarcely worth refutation. Who can be so weak as to believe that the verses, already quoted, were written in the time of Æneas? One needs only to have seen the language of the twelve tables, to be able to judge how little resemblance the ancient language of the Romans, and consequently that of the period of the kings of Alba, bore to those Latin verses. In regard to the lamp of Venus, which occasioned so much difficulty to St. Augustine, we shall observe that this author does not say that it was never supplied with new aliment. The lamps of Cassiodorus may be explained with equal ease; they were lamps which supplied themselves with oil by means of a reservoir; and Cassiodorus only meant to say, that these lamps lasted a long time, in comparison of the common lamps of that period, which stood frequently in need of having oil poured into them. We must therefore say that both history and sound criticism oppose every idea of such an invention having ever existed.

(To be continued.)

HISTORICAL PAINTING.

HISTORICAL painting embraces the widest range of knowledge; and it is the noblest reach of art to portray action, character, expression, and all the accessories which a scene requires, with adherence to truth and nature. To represent all these, by means of a few pigments spread out on paper or canvass, with such skill as to exhibit to the view a transac-

tion of past times, is justly deemed surprising, and worthy of the highest admiration.

The ability to judge of pictures in this high department of art, demands all the knowledge that can be acquired by education and by intercourse with the world; and this, indeed, furnishes, a good test of mental accomplishments in taste and judgment. If we know nothing of the history of a subject, the composition becomes to us a mere hieroglyphic, whose forms we may idly speculate upon, and vaguely inspect the arrangement of colors, the design, the character, and the expression; but all must remain destitute of meaning. In historical pieces, whether cheerful or melancholy, there should be one predominant action, and if subordinate interests be introduced, these should all be in accordance with the chief action, and such as might proceed simultaneously at the same moment of time. The chief individual or the principal group should be conspicuous, and all the subordinates should contribute to the illustration of the subject, so as to render the design easily comprehended.

The personages in the scene should be represented, with strict attention to character and peculiarity of expression, while the costume, the architecture, the most trifling objects which become accessories, should be chronologically correct, and all be made to contribute to the elucidation of the scene.

Above all, there should be a grace and a grandeur arising from chaste design, harmony of colors, and natural effect; and when these are united in a picture, we acknowledge with satisfaction, that the piece has been produced by great talent, and is worthy of approbation. "That composition," says Webb, in his inquiry into the beauties of painting, "must be sadly defective which cannot, to a careful observer, point out its own tendency; and those impressions must be either weak or false which do not in some degree mark the interest of each actor in the drama. In nature, we readily conceive the variety and force of characters, why should we not do so in pictures? What difficulty can there be in distinguishing whether the airs of the heads be mean or noble, the style of the design vulgar or elegant?" On examining the component parts of an historical picture, the drawing must first be considered. It may be tame, almost approaching to insipidity; it may be vulgar, almost to caricature; it may be deficient in action; or it may be extravagant, striding a step beyond the sublime. On the other hand, the subject may be chaste and graceful, at the same time possessing all the characteristics of grandeur. Each of those varieties of outline may be drawn with attention to anatomical correctness, and in emulation of the antique,—though there will be little difficulty in determining their real characteristics.

The next points to be examined are the light and shade. These may be so arranged as to render it difficult to discover the principal; or so that the eye of the spectator is dazzled by conflicting lights; or the lights and shades may be violently opposed; or they may be feebly contrasted and void of effect; or all could be disposed so as to present the principal in a breadth of light, to which the eye would be instantly directed, while the subordinate lights and masses of shade contributed to the character of the subject. Now, though each of these modes of disposing light and shade were pencilled in the best manner of which art is capable, there could be no difficulty in deciding which it would be the most judicious to adopt.

Color comes next in the order of examination ; and its varieties not only contribute to beauty of representation, but are powerful auxiliaries to the character and richness of the subject. Colors may be rapid, and even monotonous ; they may be deficient in clearness ; they may be so injudiciously arranged as to injure each other in effect ; or they may be so gaudy as to distract the attention of the spectator. But colors can be so managed, as to be clear in their tints, beautiful by harmonious contrast, tasteful by their chasteness, presenting a faithful transcript of nature. There can be no doubt which of these two modes ought to be preferred. The union indeed of bold outline, breadth of light, transparent shades, and harmonious colors, cannot fail to produce a powerful effect.

Color has been considered by poets as one of the chief beauties of nature ; and by painters it has been made a chief object of study, though each has adopted different combinations according to his individual taste. In the praises bestowed on Grecian painters, who are said to have been excellent colorists, every eulogium will be found to depend upon that beauty of hue which faithfully represents nature. A Grecian painter, in his endeavour to give superiority to a figure of Helen, had covered her with all the splendor a jeweller could supply. On showing it to Apelles, the great painter tauntingly rebuked him : " So, young man," said he, " failing to make her beautiful, you have made her fine."

Titian is one of the great masters, who is most esteemed for the truth and beauty of his coloring, and his harmony is less indebted to power of light and shade, than to that gradation of tone which so closely resembles nature. His tints are remarkably clear and beautiful, and yet there is no parade of art, no violence of contrast ; but all is produced without any indication of unusual effort, while to the purest taste in execution, he adds the most delicate refinement of hue and brilliancy of effect. Rubens is distinguished for the splendor of his coloring, particularly in his larger pictures. He has subdued the gaudy appearance, which would otherwise have arisen from an assemblage of the richest tints by contrasting and balancing the strength of one against the brilliancy of another, in a mass as well as in detail, with the utmost attention to general harmony and effect.

Sir Joshua Reynolds has admirably pointed out the effects of an assemblage of colors in a picture. " Coloring," he says, " is true when it is naturally adapted to the eye, from brightness, from softness, from harmony, from resemblance ; because these agree with their objects in nature. But with all this variety, a picture should possess repose ; the eye should not be perplexed and disturbed by a confusion of equal parts or equal lights, nor offended by an unharmonious mixture of colors."

Sir Martin A. Shee, in the notes to his *Elements of Art*, says he knows no standard by which works of art may be judged, but the standard of nature ; and he conceives that there is no rational principle which can authorize us to consider as inappropriate the perfection of any quality which she has essentially connected with the character and beauty of her productions. Every scene natural or imitated is made up of form, color, and light, however these may be expressed under the various modifications of action and passion, of heat and reflection, of light and shade. These are the elements of every picture presented to our eye by the hand of nature or of art, and according to their purity and perfection we are pleased.

Barnet, in his *Hints on Coloring*, after having extracted various opinions on different situations of colors, as best calculated to produce the most pleasing effect, combats them all by stating that such maxims could only produce a school of monotony. Pleasure can only be conveyed to the mind by imitating the variety ever existing in nature. He further observes, that the most agreeable colors are those to which the eye has been accustomed, consequently such appearances must be selected for imitation by admitting due portions of such colors into a picture ; if they be more vivid, the charm will be destroyed. " Harmony," he adds, " consists in the true equilibrium of the different colors employed, regulated by the general tone of the light by which they are illuminated."

" It is not enough," says Richardson, " that colors are beautiful, abstractly considered. In painting, they must assist in giving beauty to each other. There is a lightness, thinness, transparency, a warmth and delicacy pervading the combinations of colors, acted on by the atmospheric hues, from morning grey, through all the intermediates, to glowing eve. These effects cast their influence over all, breaking and harmonizing colors into corresponding sweetness, with which the eye is delighted and the mind satisfied."

To those who have contemplated an immense historical subject, crowded with figures presenting a vast assemblage of forms and combinations of colors with powerful effect, the idea of attempting to sketch the outline of a piece of such magnitude, may appear startling and impracticable, till the steps are investigated, which lead to such magnificent results? If all the means indeed which have been resorted to by the most distinguished in art, could be enumerated to the student, many a commencement would appear mere scratches, feeble indications of something which being worked upon and improved, conducted the artist through many an arduous day to perfection.

The greatest power is not always the result of size nor connected therewith. " Designs that are vast," says Burke, " only by their dimensions, are evidences of a common and low imagination." It may often be found indeed, even within the space of a few inches on paper, more truth and beauty have been expressed than on many yards of an adjoining canvass.

Several artists of eminence, among whom may be mentioned Murillo and Gainsborough, have by means of a figure or two produced surprising and delightful effects, solely by adherence to the simplicity of nature, and the student is particularly recommended to study and select from subjects of this description. By properly considering these remarks, the student will find ample field for reflection on the modes best adapted for commencing an original simple composition. When a subject presents itself to the imagination, it will in most cases be associated with situation, attitude, and perhaps expression, while the more simple the subject the more easily will the idea be matured, and some good picture or some good print may give rise to suggestions for improving the original conception. As authors study the works of those who have preceded them in their own line, so should the students of painting study the works of painters, who have painted subjects similar to those they select. In this sort of study, however, all direct copying must be avoided, and even imitations, if originality be aimed at : though this is not meant to preclude de-

living knowledge from their peculiar manner of management. All artists have done this, from the time of the celebrated Angelos, down to the present time; and it cannot in any sense of the word be deemed plagiarism to observe how any artist may have drawn or given effect to his pictures, for all are entitled to profit by this if they can discriminate it; but as Sir Joshua Reynolds said, whatever is appropriated in this way should be managed with Spartan circumspection, so that no one shall be able to discover where the booty was obtained.

(To be continued.)

PALM AND COCOA NUT OIL.

PALM oil is obtained from the fruit of some species of palm growing in several places in Africa, especially in Senegal. The two trees which principally produce this oil are the *Cocos butyracea* and the *Elais guineensis*. They both bear fruit abounding in oil. The first species, from which the oil is most commonly extracted, grows to the height of fifteen or sixteen feet, and flourishes most in shady places. The fruit or nut resembles a date stone. When ripe it is heated by fermentation, and then coarsely pulverized in hollow cylinders, by which its oil parts are separated; it is subsequently macerated in hot water, when the oil gradually collects on the surface, and cooling, concretes into a thick, unctuous cake, of a light lemon color, with little or no taste, but having a rich perfume. At the ordinary temperature of the air this is not a fluid oil: at 69° Fahrenheit it begins to be slightly opaque, at 62° it is of the consistence of honey, at 45° it is proportionably thicker, but still retains a degree of softness. It is heavier than most other expressed oils, its specific gravity being .968. The oleaginous proportion of these palm-nuts is very considerable, one gallon of them usually producing a quart of oil. This is used as butter by the natives of the gold coast, forming part of all their culinary preparations, and when eaten fresh is a delicate and wholesome article of diet, differing as much from the palm oil imported into England, as fresh butter from that which is rancid. It is used in this country in the manufacture of a particular kind of soap, as well as in the composition of some pomades, and other perfumery.

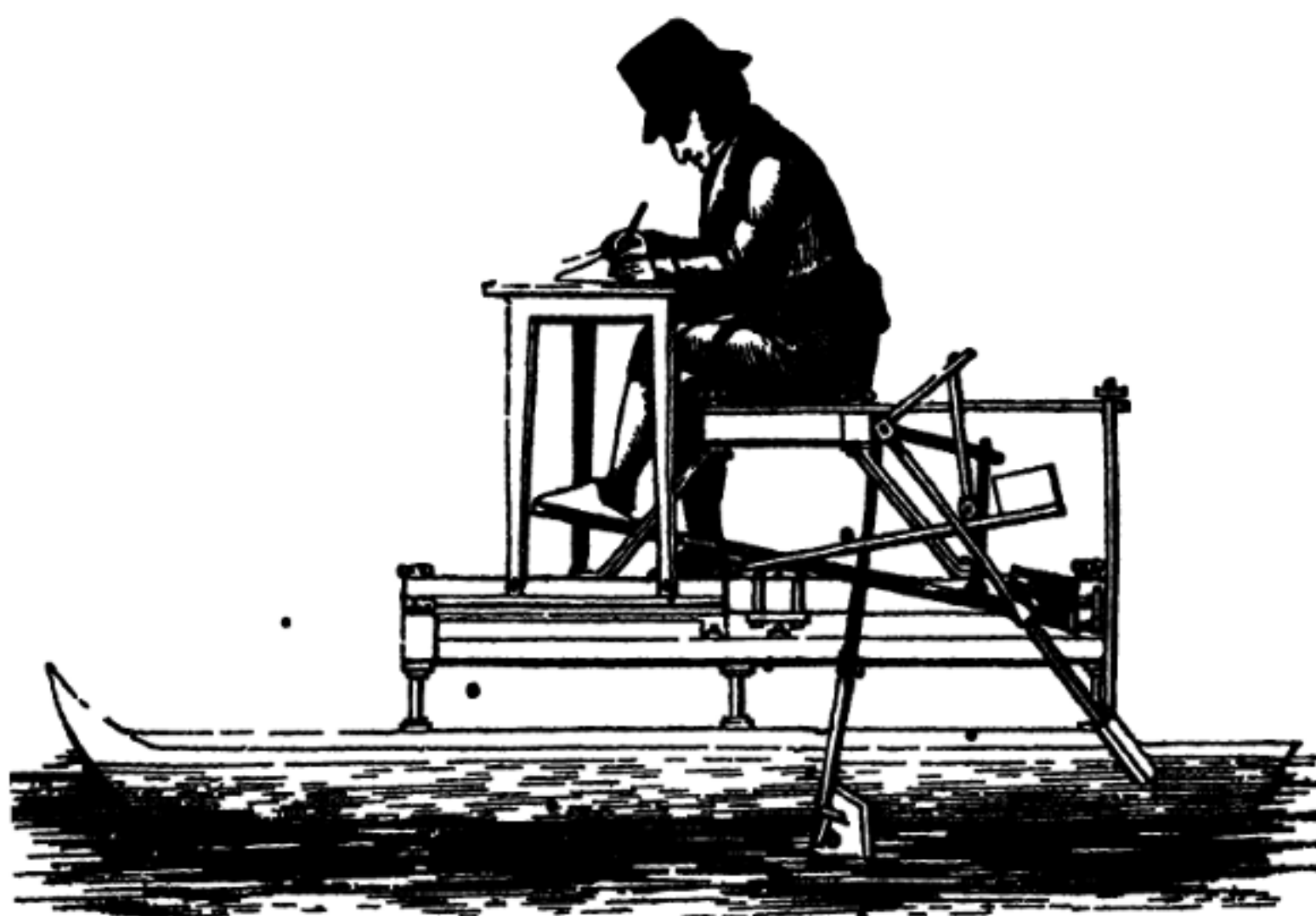
The kernels of cocoa-nuts contain a considerable proportion of oil, which may be extracted and applied with great advantage to those uses in which other unctuous substance is employed. This oil congeals at the ordinary temperature of the atmosphere in England, and appears under the form of a white concrete substance. It was first introduced from Ceylon into this country at the beginning of the present century; and many exertions have been made by those interested in its introduction to promote its extensive consumption. Cocoa-nuts are produced in so great profusion in Ceylon that the large quantities of oil which could be obtained from them, at a reasonable rate, might become a source of great profit to that island. When it was first imported here many trials were made of its quality. It was found that the soap-boiler could manufacture with this oil soap almost equal to that made with olive oil, and at a much lower price. For the same branch of manufacture it proved to be far superior to tallow, which it exceeded in cost only about ten per cent.

Next to the purposes of bodily unction the greatest use the Cingalese make of this oil is that of illuminating their apartments. Their lamp also is furnished by the same bountiful tree, for they burn the oil in an open section of the cocoa-nut shell. The European settlers as well as the natives universally use it for lamp oil, and praise it for the pure beautiful light it emits; though even in Ceylon, at a certain reduction of temperature, it occasionally congeals and becomes inconvenient. An English officer on that station has informed us, that in the absence of a thermometer, and from long practice, he often judged of the state of the atmosphere from the condition in which he found his extinguished cocoa-nut lamp on rising in the morning.

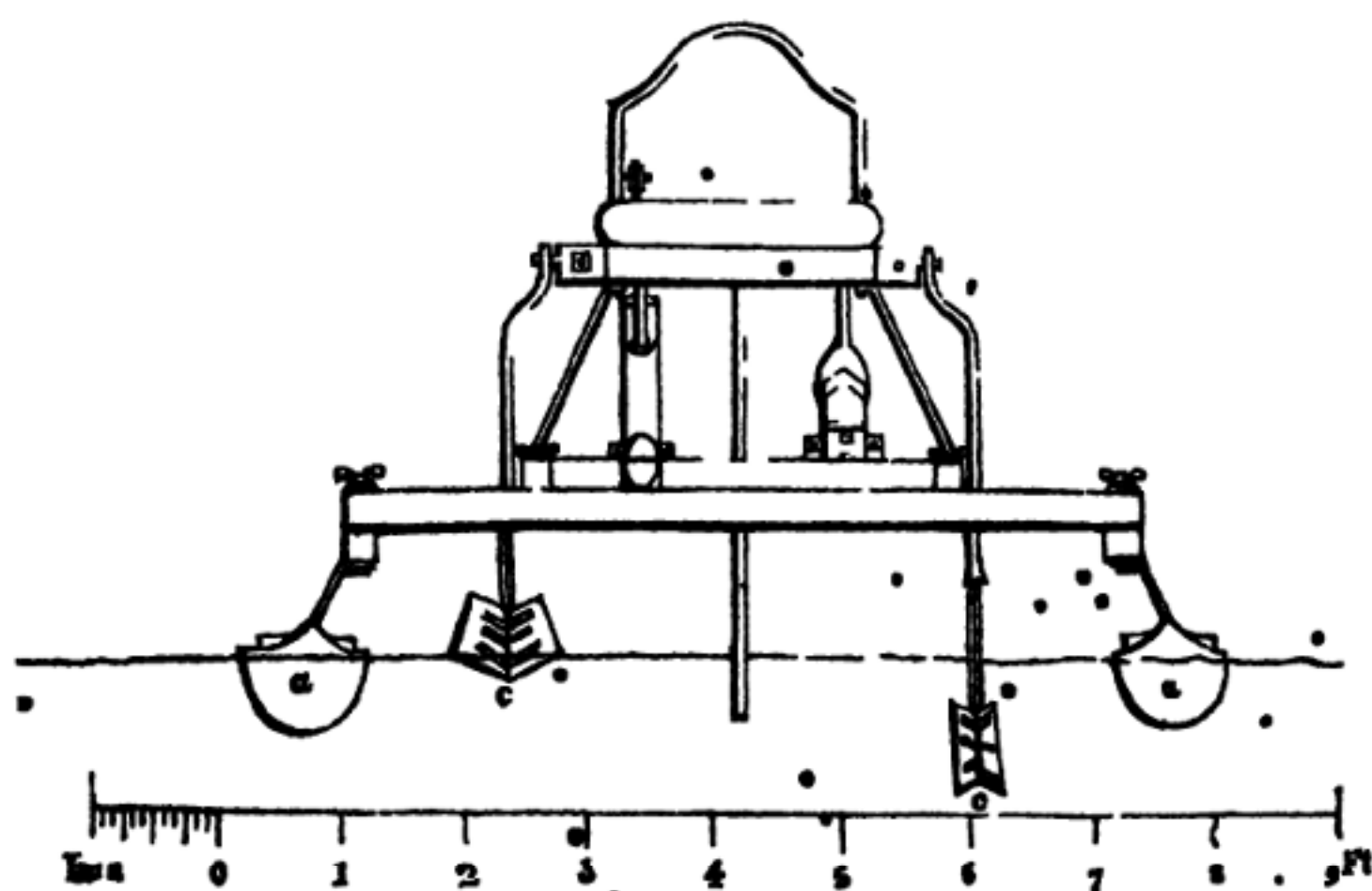
It has been attempted to adapt this oil to the purpose of illumination in England, and some particular lamps were constructed in which the oil, as imported, could be burnt; but its appearance under a different form to the limpid fluid which is ordinarily consumed, and the management required in consequence for its equable combustion, caused its use in this way to be very circumscribed. Recently, however, a discovery has been made of a method for separating the concrete matter from the liquid part of cocoa-nut oil—producing a pale, limpid, tasteless fluid, possessing the property of combustibility in an equal degree with the best sperm oil, while the solid unctuous substance is applicable to the manufacture of candles, and to other uses in which fatty matter is generally employed.

In the year 1815, and during a few succeeding years, considerable interest was taken in this country by mercantile houses connected with the island of Ceylon, to discover the most efficient manner of obtaining oil from the cocoa-nut; and accordingly many methods were pointed out, and machinery with directions for its use was shipped from England to that island. The Cingalese, or natives, extracted the oil from the kernel of the cocoa-nut either by the process of decoction or by compression. The process of decoction rendered by far the best quality of oil, but it was slow and tedious.

The separation of the fluid and concrete parts of the oil is now produced in this country by pressure. The use of this process, and of the subsequent preparation of the solid part, is secured to the inventor by patent. The oil is obtained by putting the congealed cocoa-nut oil of commerce into strong linen bags; these are covered with thick sackcloth, and laid flat upon the horizontal bed of an hydrostatic press, leaving a small vacant space between the bags. Pressure is then given to them and continued until the oil ceases to flow through into a cistern fixed beneath. After the oil has remained a sufficient time at rest for the subsidence of its impurities, it is drawn off quite clear. The residue in the bags is found to contain many impurities, such as fibre, mucilage, and other extraneous matter. It is therefore necessary to disengage it from these, for which purpose the whole is put into a tinued copper boiler, which is covered and immersed in a water-bath; to prevent the liability of an excess of heat. Two per cent. in weight of sulphuric acid of 1.8 spec. grav. diluted with six parts of water, is then added. The action of the acid, aided by heat, coagulates and precipitates the impurities, which may then be removed either by straining or filtering, while warm and in the fluid state; or by their being allowed to subside and become cold when they are separated.

Fig 1

CURIOUS BOAT USED AT NYMPHENBURG

*Fig. 2.*

CURIOUS BOAT USED AT NYMPHENBURG.

A SINGULAR, and to us a novel exhibition is to be seen during the summer season on many of the ornamental waters in the gardens of Holland. In fact, the Dutch have always been celebrated for their mechanical ingenuity, and employ numerous contrivances for their amusement and exercise which are unknown to us, and if these matters are not of essential utility, we must admit that their formation calls into exercise much mechanical knowledge, and adds a greater variety to the healthful amusements of the people. In this manner we view the ordinary contrivances of manual locomotives, velocipedes, paddle-wheel boats turned by a winch, and other things of a like character.

The boat which has occasioned this remark we have the more pleasure of introducing, because we have been solicited for an opinion upon the construction of such a one by three or four correspondents at different times. Fig. 1 shows the boat as it appears when on the water. Fig. 2 shows the transverse section. It consists of two small boats shown in Fig. 2 at *a a*, fastened together by a platform reaching from the deck of one to the deck of the other. The platform is however supported at some distance above the level of the boat, as is seen at Fig. 1; for the purpose of getting a longer leverage to the paddles. The platform has a chair and a table placed upon it, the chair having a bent lever on each side. To the upper projecting ends of the bent levers are short rods, which connect them with the treadles. Upon the person in the boat working alternately with his feet upon the treadles, the paddles alternately move into the water, and propel the boat forward; observing that the paddles are made of two pieces fastened to each other by hinges, so that drawn through the water in one direction, they occasion little or no impediment, while in the contrary direction by the paddle expanding, it causes that resistance necessary to propel the boat, (as is seen at *c c*, Fig. 2;) both feet being used at once, the boat proceeds with considerable rapidity, and the boatman's hands are always at liberty, either for angling, sketching, or any other purpose.

COUNTERFEIT MEDALS.

COUNTERFEIT medals fall into six classes; namely,

1. Medals known to be modern imitations of the ancient; but which being by masters have their value.

2. Medals cast from these modern masterly imitations.

3. Medals cast in moulds taken from the antique.

4. Ancient medals which are retouched, and the obverses or reverses altered.

5. Medals which are impressed with new devices, or which are soldered.

6. Counterfeit medals which have clefts, &c. which are plated.

Class 1.—These are so numerous that a complete series of imperial medals, of almost every metal and size, may be formed of them alone; nay, a numerous collection of medallions themselves. In France particularly they so swarm, and so impose upon the unknowing, that far the greater part of the coins in country cabinets, upon being brought to Paris for sale, are found to be of this stamp. A connoisseur however easily distinguishes them by these marks:—

1. They are almost universally thinner than the an-

cient. 2. They are never worn nor damaged. 3. The letters are forked and modern. 4. They have either no varnish, or it is false, which is easily discerned, for it is black, greasy, and shining, besides being very tender when touched with a needle or graver, while the ancient has none of these qualities, and is hard as the coin itself. 5. The sides are filed, which is discoverable by the least attention, or they are too much smoothed by art, or bear marks of a small hammer. 6. They are always very circular, which the ancient are not, especially after Trajan. All medallions from Julius Cæsar to Hadrian are much to be suspected of this fabrication; those of the first fourteen emperors, when true, being of vast value, and only to be found in princely cabinets.

Hence it may be observed, once for all, that the letters of the legend form the very surest test of medals: those of modern medals being always modern, while the ancient have many rude peculiarities, such as the *M* always in this form *M*, and not with straight strokes; which, with many other little differences, constitutes an infallible distinction.

Class 2.—These are sometimes more difficult to discern than the former, because that, in casting them, they give them what thickness they please; and, filling with mastic the little cavities which the sand leaves, they re-touch the letters with a graving tool, and mask the imposition with varnish. However, most of the instructions given for the first class likewise avail in this, with another distinction, which is, that coins of this class are always much lighter than true medals of their size, because fire rarefies the melted metal, while that which is struck is condensed, and becomes of consequence more weighty. Those which are cast in gold or silver, either in this way or from the antique, betray themselves, as these metals admit no varnished imitation of rust.

The marks of the file on the margin of these form a sure badge of falsity, as in the first class; but it must be observed, that these marks, in gold or in silver coins, by no means declare them modern, when they constitute the sole suspicions; for the ancient Romans often filed coins in these metals, that they might be encased in rings, around vases, or the like: as we sometimes have quarter-guineas, &c. inserted in the bottom of punch ladles. It is a common trick, in this class of counterfeits especially, to cover a false coin with wax, then pricking it on the margin, to drop aqua-fortis into the holes. This destroys the sides of a coin more effectually than if it had been eaten into by time. The amateur must be upon his guard against this fraud, which is not easily distinguishable, and bear it in mind that a medal eaten into on the sides may yet be modern, and a filed medal of gold or silver may, notwithstanding this suspicious appearance, boast indubitable antiquity.

Class 3.—Those distinctions which serve in former classes are likewise to be used in this. M. Beauvais informs us, that skilful workmen in this way, when about to forge coins of gold or silver, are sometimes so careful that the quality of their metal shall not betray them, that they will melt a common medal of the very emperor whom they mean to counterfeit, in order to give it the new device of a rare one of the same prince. This has been done in the silver Septimus Severus, with the reverse of a triumphal arch, for which a common coin of the same prince had been melted, and in other instances. Putting medals in the fire or upon hot iron, to cleanse them,

gives them an appearance of being cast; for some spots of the metal, being softer than the rest, will run, which makes this one of the worst plans of cleansing medals.

Class 4.—This is the species of deception which is the most apt to impose even on the skilful; and one must know a good deal of medals not to be the dupe of it. The art exerted in this class is astonishing; and a connoisseur is apt the less to suspect it, as the coins themselves are in fact ancient. The acute minds of the Italian artists exerted themselves in this way, when the other kinds of forgeries became common and known. With graving tools they alter the portraits, the reverses, the inscriptions themselves, in a surprising manner. Of a Claudius, struck at Antioch, they make an Otho; of a Faustina, a Titiana; of a Julia Severi, a Didia Clara; of a Macrinus, a Pescennius; of an^a Orbiana, an Annia Faustina; of a Mamæa, a Tranquillina; of a Philip, an Emilian. Give them a Marcus Aurelius, he starts up a Pertinax, by thickening the beard a little, and enlarging the nose. In short, wherever there is the least resemblance in persons, reverses, or legends, an artist of this class can, from a trivial medal, generate a most scarce and valuable one. This fraud is distinguishable by the false varnish which sometimes masks it; but, above all, by the letters of the legend, which are always altered; though this is sometimes done with an artifice almost miraculous; yet most commonly the characters straggle, are disunited, and not in a line. Medals of this class are often met of which the obverse has not been touched, but the reverse made hollow, then filled with mastic of the color of the coin, which is engraved with such device and legend as the artist knew was uncommon, and would bear a great price. Others are only re-touched in some minute particulars, which however very much diminish the value of the coin. Against all these arts severe scrutiny must be used by the purchaser upon the medal itself; and the investigation and opinion of eminent antiquaries had upon its being altered, or genuine as it issued from the mint.

Class 5.—The first article of this class concerns those medals of which the real reverses have been totally filed off, and new ones impressed by dint of a die and the hammer. This is done by putting the face or obverse, whichever is not touched, upon different folds of pasteboard, and then applying the die, and impressing it with strokes of a hammer. Most of such coins of themselves betray their falsity; the devices and inscriptions being such as are known not to exist upon real medals. Such as the *Pons Ælius* on the reverse of Hadrian; the *Expeditiō Judaica* of the same emperor; and the like. Besides this, another infallible token is the difference, more or less, in the fabrication of the face and of the new reverse. This an eye of any skill will always discern at first glance.

Soldered medals are those which consist of two halves belonging to different medals sawn through and then joined with solder. This deceit is common in silver and in brass. They will take an Antoninus, for example, and saw off the reverse, then solder to the obverse a Faustina which they have treated in like manner. This makes a medal which will, from an unknowing purchaser, bring an hundred times the price of the two coins which compose it. Medals which have a portrait on each side, and which are always valuable, are the most liable to suspicion of this fraud. To a very nice eye the minute ring of the solder is always visible; and

upon inserting a graver the fabrication falls in halves. It may be worth while to observe here, that many reverses in coins of the lower empire are so unconnected with their obverses, that they inspire a mistaken suspicion of this forgery. These occur especially after the days of Gallienus, when numerous usurpers walked over the tragic scene of empire so fast that it was difficult to catch their features. The coiners had scarcely time to engrave a portrait of the emperor, much less to make his medal an appropriated monument of adulation. Hence *PACATOR* occurs on a reverse of Marius, who reigned only three days; and innumerable others, which are owing to the coiners stamping the medals of these fugitive sovereigns with reverses, which they had ready fabricated for some preceding monarch whose reign was at least of sufficient duration to afford time for engraving a reverse.

Class 6.—Many true medals are split on the sides, owing to the ancient method of striking them with repeated strokes of a hammer. As these clefts were regarded as infallible marks of antiquity, those artists who wish to impose on the collector of medals in every shape readily set themselves to imitate them. This they did by filing an incision upon the margin of the coin as much resembling the casual clefts as possible. But this flaw is easily distinguishable from the casual by its being wide at the extremity, and going straight in, ending at once in a point, and not with those, almost imperceptible filaments which terminate the genuine. Add to this, that the two sides of an antique cleft correspond to each other by mutual chinks and protuberances, which are imitable by the file, so that the distinction is by no means a task of difficulty. If the filaments of the real clefts are attempted to be imitated, a small needle will easily decide of their depth and reality.

PERPETUAL LAMPS.

(Resumed from page 166, and concluded.)

To obtain a perpetual lamp it would be necessary to have as follows:—

First. A wick which could not be consumed.

Second. Some aliment which could not be consumed, or a substance which, after having served as aliment to the fire, should return into the vessel without losing its inflammable quality.

Third. It would be necessary also that the flame should be able to exist a long time in a place absolutely close, and of small dimensions; for such were the tombs in which these perpetual lamps are said to have been found.

The curious properties ascribed to the amianthus, which are in part real, are well known. The amianthus, called also incombustible flax, and asbestos, is a mineral substance found in several parts of the earth. It consists of fibres of a white color, more or less greyish, which adhere strongly to each other. Means however are found to separate them, and when well washed they have the appearance of the whitest flax. The amianthus is found in the Pyrenees, the Alps, &c. The most beautiful is that found in or near the mine of Pessey, in Savoy. But the singular property which characterizes this substance is, that it remains unhurt in the fire, and when taken out is purer and whiter than it was before.

To form the amianthus into wick, it is not necessary that it should be purified or spun. It will be sufficient to take the longest filaments, and to tie them together with a white silk thread, in a quantity proportionate to the size of the wick. It is astonish-

ing to see with what avidity the amianthus attracts and imbibes the oil. It may be employed as it is found in filaments, in the druggists' shops, and the lamp will not fail to burn and to emit a strong light. If we can believe the partisans of perpetual lamps, since the first step towards the execution of such a work as a perpetual and incombustible wick, we have the object accomplished; for the amianthus supplies us with such a wick, since it is incombustible, and since the trials made of it have been attended with success. Father Kircher assures us, that he had a lamp with a wick of this kind, which answered exceedingly well.

We will not deny that it is possible, by means of the amianthus, to make a wick, which will last for a very long time; but we will assert that it would not be perpetual; for though the amianthus is boasted of as being incombustible, this property is not absolute. We will even venture to say, that the amianthus is at length annihilated by fire, like every other body. It is true that cloth of the amianthus, when thrown into the fire, is taken out sound and entire, but not absolutely so. It is observed that it loses a little of its weight every time it is exposed to the fire. It would therefore be at length destroyed, and perhaps in the course of a very short time, such as a few days, if it were only made red hot and suffered to cool, or if it were left all that time in a very strong fire. Consequently a wick of amianthus would, at the end of a certain period, be destroyed.

But we shall even suppose a wick absolutely unalterable to have been found, and that it does not become choked up with fuliginous matter, from the combustible substance by which it is fed. This however would be only a small part of what is necessary for obtaining a perpetual lamp. Some kind of aliment, which shall experience no diminution, or which having served to maintain the flame without experiencing any alteration, may return by a perpetual circulation into the vessel from which it issued, will also be requisite. Is all this possible?

But let us now hear the alchemists, or the partisans of perpetual lamps. We shall be entertained with their ideas respecting the manner in which an oil, such as these lamps would require, might be obtained. Some, considering that the amianthus resists fire, have tried, but without success, to extract an oil from it. Others, observing that gold and silver, but particularly the former of these metals, are indestructible by fire, conceived an idea of searching in them for that valuable oil which would put us in possession of perpetual lamps. This is the noble secret with which Liceti pretends that Olybius was acquainted; but the metals are as incapable of producing oil as the amianthus. It may however be said, that if it were possible to reduce gold to a liquid state, we might perhaps obtain an incombustible oil, as gold is unalterable in the fire. But besides the impossibility of converting gold into a liquid, how do we know that it would be inflammable like oil.

The Abbot Trithemius, or the person who in his name has written a great many falsehoods, pretends to give two recipes for making incombustible oil. We shall here lay one of them before our readers, with the whole process for making a perpetual lamp. "Mix," says that celebrated visionary, or the person who speaks in his name, "four ounces of sulphur and four ounces of alum; sublime them, and convert them into flowers. Take two ounces and a half of these flowers with half an ounce of borax and Venetian crystal, and pulverise the whole in a

glass mortar. Put the powder into a phial, and having poured into it spirit of wine, four times rectified, cause it to digest. Pour off the spirit of wine and having added some new, repeat the same thing three or four times, until the sulphur runs without smoke, like wax on hot plates of brass. You must then prepare a proper wick, which may be done in the following manner: Take filaments of the abestos stone, of the length of the finger; form them into a packet half as thick as the finger, and tie them with a white silk thread. The wick being thus made, cover it with the sulphur prepared as before described, and immerse it in the sulphur, in a vessel of Venetian glass. Place the whole upon a sand bath for twenty-four hours, so that you may always see the sulphur boil; and the wick being by these means well penetrated and impregnated with that aliment, put it into a small glass vessel with a wide mouth. The match must rise a little above it. Then fill this glass vessel with the prepared sulphur, and place the vessel in warm sand, that the sulphur may melt and surround the wick. If it be then kindled, it will burn with a perpetual flame."

Such is the first kind of fire of the Abbot Trithemius. A very small knowledge of chemistry is sufficient to show that it would be ridiculous to expect from this process inextinguishable and perpetual fire. None therefore of the partisans of perpetual lamps, not even Liceti himself, have any confidence in it, nor yet in the second; from which Liceti concludes that none of the moderns possess, or ever possessed, this valuable secret.

Some alchemists assert that an incombustible oil may be obtained by another process. They pretend that oil of vitriol edulcorated on gold, which they call *oleum vitrioli aurificatum*, will give this valuable liquor. But it is well known that the appellation of oil is here improperly applied; for what is called oil of vitriol has in reality nothing of an oily or inflammable nature; and we shall believe in perpetual lamps when an alchemist shall show us a common lamp, filled with oil of vitriol, and furnished with any wick whatever, in which the flame shall exist only one second.

It is a fact, well known to all those who cultivate natural philosophy, that flame cannot be maintained in a close place. If a lighted taper be placed under a glass receiver, so as to prevent its having communication with the external air, the flame will gradually decrease in size, become faint, extend itself in length, and at last be extinguished. Dr. Hales and others have even calculated what quantity of air is consumed in a certain time by the combustion of a taper of certain dimensions; so that we may easily predict in what time the flame will be extinguished.

A flame however might perhaps be maintained in a large place, though hermetically sealed; but it is well known that the cavities of the ancient lamps were exceedingly small; and to increase the difficulty it is said that the perpetual lamps burnt in the vessels in which they were inclosed. Such at least was the case with that of Olybius; but if the vessel of Olybius had been three feet in diameter, which by no means appears, it is certain that a lamp could not have existed in it two hours without being extinguished.

We shall not enlarge farther on this subject, as it would be wasting time to accumulate arguments to combat the chimera of perpetual lamps; and we have reason to think that every enlightened philosopher, at present, will be of the same opinion:

ROAD MAKING.

When it is proposed to construct a line of road extending between two places, the engineer upon whom such a duty devolves first makes himself well acquainted with the surface of the country lying between the two places, so as to obtain an acquaintance with the face of the country, somewhat approaching to that which would be supplied by a superficial model of it, which would exhibit all its inequalities and undulations of surface. He is then to select what he considers, all circumstances being taken into account, the best general route for the proposed road. But, previously to laying it out with accuracy, it is necessary to make an instrumental survey of the country along the route thus selected; taking the levels from point to point throughout the whole distance, and making borings in all places where excavations are required, to determine the strata through which such cuttings are to be carried, and the requisite inclinations of the slopes or slanting sides, as well of the cuttings as of the embankments to be formed by the material thus obtained. It is also requisite, in the selection of the route for the proposed road, to have regard to the supply of materials, not only for first constructing it, but for maintaining it in repair; thus, the position of gravel pits and quarries in the neighbourhood of the proposed line, and the modes of access to them, should be well ascertained.

The results of such an investigation should be reduced to a plan and section; the plan of the road being on a scale not less than 66 yards to an inch, and the section not less than 30 feet to an inch.

The loss of tractive power, and dangers to travellers produced by steep acclivities, render it especially necessary that a proper limitation should be imposed upon the inclinations or acclivities on every line of road on which much traffic is carried on. As, however, this reduction of hills in a country where much inequality of surface exists is attended with a considerable outlay of capital, the engineer will have to balance the cost of constructing a road having the best possible inclinations against the advantages to be obtained in the permanent working of the road; and if the expected traffic be not such as to yield advantages proportionate to the capital absorbed, greater rates of inclination must be allowed to the hills, with a view to diminish the extent of the works, and to render the expense of constructing the road proportionate to the traffic expected upon it.

A dead level, even where it can be obtained, is not the best course for a road; a certain inclination of the surface facilitates the drainage, and keeps the road in a dry state. There is a certain inclination, depending on the degree of perfection given to the surface of the road, and on the structure of the carriages worked upon it, which cannot be exceeded without a direct loss of tractive power; this inclination or acclivity is that in descending which at a uniform speed the traces slacken, or which causes the carriages to press on the horses: the limiting inclination within which this effect does not take place is called the *angle of repose*.

On all acclivities less steep than the angle of repose, a certain amount of tractive force is necessary in the descent as well as in the ascent; and the mean of the two drawing forces, ascending and descending, is equal to the force along a level road. Thus, on such acclivities as much power is gained in the descent as is lost in the ascent; but on acclivities which are more steep than the angle of

repose, the load presses on the horses during their descent, so as to impede their action, and their power is expended in checking the descent of the load; or, if this effect be prevented by the use of any form of drag or break, then the power expended on such drag or break corresponds to an equal quantity of mechanical power expended in the ascent, for which no equivalent is obtained in the descent.

On well-constructed roads, with carriages such as now are generally used in England, the angle of repose may be taken at about one in thirty-six; and this is consequently an acclivity which ought not to be exceeded on roads over which much traffic is carried.

The expedients by which the requisite inclinations are obtained on common roads are the same as those which are resorted to in the construction of rail-ways.

The exact course of the road and the degree of its acclivities being determined, the next thing to be considered is the formation of its surface. The qualities which ought to be imparted to it are twofold,—first, it should be smooth; secondly, it should be hard; and the goodness of the road will be exactly in the proportion of the degree in which these qualities can be imparted to it, and permanently maintained upon it. An error prevailed among road engineers until a very recent period. It was considered that smoothness of surface alone was sufficient for the perfection of a road; and that, provided it could be made sufficiently durable, it was unimportant how soft or yielding the coating of the road might be. This error, into which, among others, Macadam himself fell, was based upon a neglect of one of the most important circumstances to be considered in the construction of a road. The main object to be attained by all roads is the diminution of the resistance which a carriage opposes to the tractive power. Other things being the same, it was sufficiently apparent that this resistance would be diminished by increasing the smoothness of the road surface. But roughness or unevenness of surface is not the only cause of resistance to the tractive power; if two roads have their surfaces equally smooth and even, but one is soft and elastic, so as to yield under the pressure of the wheel, recovering its form as the wheel advances, and the other is hard and unyielding, the resistance to the tractive power will be greater on the soft and yielding road than on the hard and unyielding road; and this augmentation of resistance will be in proportion to the softness of the surface. That this would be the case, admits of immediate demonstration on mechanical and mathematical principles; but, without resorting to these, it must be sufficiently apparent from the results of the most common experience. A surface of velvet may be as smooth and even as a surface of ice; but if an ivory ball be rolled on the latter, it will continue its motion much longer than on the former. In fact, the wheels of a carriage in passing along a soft road sink into its surface, as the ball would sink into the pile of the velvet; and although, in virtue of its elasticity, the surface of the road, like that of the velvet, may recover its smoothness after the pressure has been removed from it, still a resistance will be offered to the drawing or impelling power, which would not be produced by a hard unyielding surface equally smooth.

Macadamization.—This process, which has received its name from Macadam, to whose labors the improvement of the roads of England within the last half century owes so much, consists in forming the road crust of stones, broken with a hammer

into angular pieces of a small and uniform size. This method, however, is one which was long practised in various parts of Europe. When the stones of which the road crust is to be formed are broken to the proper magnitude and form, they are spread over the surface of the road in a layer of 3 or 4 inches thick. After this has been consolidated by carriages working upon it or by rollers, another layer of broken stones of equal depth is laid upon it; it is consolidated in like manner; and thus one layer is laid over another until an artificial crust is formed of broken stones of sufficient thickness to give the requisite strength to the road. A coating or road crust thus formed might be constructed on any substratum whatsoever, and a smooth and apparently good road would be obtained. It was the practice of Mr. Macadam to disregard the nature of the substratum; and he maintained that if it was such a bog as would not allow a man to walk over it, he would even prefer it to a hard bottom.

Telford's System.—The improvement in road-making which consisted in a due attention to the substratum or foundation of the road, so as to give increased facility to the tractive power by rendering its surface hard and unyielding, is due to the late Mr. Telford. The following is a description of the method of constructing such a road practised by that eminent engineer. Upon the level bed prepared for road materials a bottom course or layer of stones is to be set by hand, in form of a close firm pavement. The stones set in the middle of the road should be 7 inches in depth; at 9 feet from the centre the depth should be 5 inches; at 12 feet, 4 inches; and at 15 feet, 3 inches; the entire width of the road being 30 feet. These stones are to be set on their broadest edges lengthwise across the road, and the breadth of the upper edge should not exceed 4 inches. All the irregularities of the upper part of this pavement are to be broken off by hammers, and all the interstices to be filled with stone chips firmly wedged or packed by hand with a light hammer; so that, when the pavement is finished, its cross section shall have a convexity of surface of about 4 inches in the centre above the extreme edges: 18 feet in the centre of this pavement are to be coated with a layer of hard broken stones, 6 inches deep; of these 6 inches, 4 must be first put on and worked down by carriages and horses in the ordinary traffic of the road, care being taken constantly to rake in the ruts until the surface has become firm and the crust consolidated. After this, the remaining 2 inches of stone may be put on; the whole of this stone, forming 6 inches of crust, is to consist of pieces broken as nearly as is practicable into a cubical form, and of such a magnitude that they can pass through a ring of $2\frac{1}{4}$ inches internal diameter. The spaces on each side of the middle 18 feet are to be coated with broken stone or well-cleansed strong gravel up to the level of the foot-path or other boundary of the road, so as to make the whole convexity of the road 6 inches in the middle above the level of the edges; and the whole of the materials thus formed and consolidated should be covered with a coating $1\frac{1}{2}$ inch deep of good gravel, free from clay or earth.

Such was the method practised by Mr. Telford in the construction of great main roads, such as that between Holyhead and Shrewsbury. In the streets of towns, and other places where roads have to bear a still heavier traffic, such a road as that above described is found to be subject to a superficial wear, so rapid as to produce an intolerable quantity of

dust in summer and of mud in winter. In such places recourse has been generally had to pavement. The first object to be secured for a durable pavement, as well as in other roads, is to secure a good foundation. The best method is to lay a foundation of gravel or broken stone, the bed of which should be formed with a convexity sloping to each side by a fall of about 1 in 50. After the first layer of broken stone is put on, the street should be open for carriages to pass over until it is consolidated, all ruts being carefully raked in. The same process should be repeated with each successive layer, until a sufficiently solid foundation is obtained for the pavement. On this foundation a pavement formed of blocks of stone is laid, the blocks being 10 inches in depth, from 10 to 16 inches in length, and from 6 to 8 inches in width. Such is the structure which is requisite for the streets which are the main thoroughfares of a great city; a pavement with less strength of foundation, and formed of smaller blocks of stone, being used for the streets of less intercourse.

The many inconveniences produced in the great thoroughfares of London, such as Oxford Street, Holborn, Fleet Street, the Strand, &c., by reason of the rapid wear of every kind of pavement hitherto adopted, a suspension of the intercourse during the frequent repairs, the dust in summer and the mud in winter produced by a surface of broken stones, and the intolerable noise produced by every species of stone pavement, have lately excited much inquiry as to the possibility of constructing some road having sufficient strength for a traffic so enormous, sufficient durability to prevent the inconvenience of the frequent suspension of intercourse by the necessity of repairs, and presenting a surface which, while it would be free from the noise of a stone pavement, would not be attended with the inconvenience of dust and mud produced by a surface of broken stone. This problem appears to be in a great degree solved by the adoption of a pavement of wood. A short piece of Oxford Street was thus paved in the beginning of 1839; and after a successful trial of several months, the same pavement was extended nearly throughout the whole extent of that street; and at the present time (1842) this method of pavement is in process of construction in several other thoroughfares of London. The idea of a wooden pavement is not new. In the northern parts of Germany and in Russia such pavements have been long in use; some of the main streets of Petersburg and Vienna have long been paved in this manner. A few years ago a series of experiments were made at New York, to determine the best description of paving for a street. One of the methods adopted was a tessellated pavement, formed of hexagonal blocks of pine wood, measuring 6 inches on each side of their transverse section, and 12 inches in depth. From the manner in which the timber is cut its fibres are vertical, and therefore the tendency to wear from vertical pressure is small. The blocks are coated with pitch or tar, forming a smooth upper surface. Various methods have been proposed for laying the wood pavements of London; but as these methods are severally as yet only in process of trial; nothing is practically known of their respective merits. There appears, however, to be sufficient to justify a well-grounded expectation that wood pavements of some form or other will soon supersede all others for the great thoroughfares of towns.

STEAM BALLOON.

La Presse states that M. Leinberger, an ingenious mechanic of Nuremberg, is about to construct a balloon of metal, which he expects to guide as he pleases. For this purpose, a subscription has been raised sufficient to cover the expenses of such a machine. This steam balloon, which is in progress of construction, may contain from three to fifty persons, with provisions for fifteen days. Every precaution has been taken to prevent the possibility of accident from fire, explosion, or want of gas; and even should the balloon fall into the sea, its construction is such, that it may continue to proceed through the water as rapidly as a steam boat. As an ordinary balloon can traverse 500 miles in twenty-four hours, the rapidity of a steam balloon, whose wheel similar to an Archimedes screw, will describe at each rotation a space of seven yards, must be considerably greater. Several skilful engineers, who have examined this machine, have no doubt of the possibility of completing this mode of transport, which hereafter will render "high roads and rail-roads useless."

[Thus far *La Presse*; we certainly are not quite so sanguine in the success of this steam balloon, and doubt if English engineers will accord in opinion with their foreign brethren.—Ed.]

NERVIMOTILITY.

It too often happens, says M. Dutrochet, that zoologists know nothing of botany, and botanists nothing of zoology. Yet the study of both should be sedulously cultivated; for doubtless they shed a mutual light on each other. They do so particularly with regard to the movements which each exhibits respectively. The limbs of animals, in general, are furnished with joints, and moved by means of muscles, which are put into motion by the agency of nerves, which are themselves excited by the agency of external stimuli. But plants have neither nerves, nor muscles, nor moveable joints, and yet the parts of many of them have spontaneous, and even visible motion. Still it is merely a bending of such parts as are soft and flexible; the organic tissue undergoing an interior movement that causes the flexion, and the recovery from flexion. By what means then is this movement effected? M. Dutrochet undertakes to show, that the movements of plants, like the movements of animals, are, in fact, effected through the instrumentality of nervous matter, and of muscular force, though not under the palpable modification either of nerves or of muscles. Hence the phenomenon may still be said to originate in the principle of *nervimotility*.

The nervous system of animals of the higher class—the Vertebrata—is essentially composed of groups of conglomerated globules cognizable by the microscope, according to the observations of the most celebrated anatomists, and microscopic observers, as Lewenhoeck, Prochaska, Home, Bauer, the Wagners, Edwards. The globules seem to be cells of extreme minuteness, containing medullary or nervous matter coagulable by heat and acids. In their aggregate they constitute the brain, from which there proceeds a spinal or vertebral marrow, sending out numerous nerves to the senses, and to the muscles of the limbs; and to which there is further appended the ganglionic system with its connecting cords and nerves, which seem in their ultimate divisions to be fine and slender

tubes filled with a diaphanous fluid. The nervous system of the lower classes appears to be wholly ganglionic. This is well shown in the case of the Molluscan Gasteropodes. The brain, or first ganglion, consists of two hemispheres, from which two cords issue embracing the oesophagus, and uniting again to form a ganglion, and so on in succession till the series is complete. The nervous system of the lowest classes is merely molecular. The Polypi and infusory animalcules are presumed to have no nerves. But they have granulations interspersed throughout their soft and gelatinous mass which resemble the globules now described, and which M. Dutrochet regards as being undoubtedly their nervous organs.

The muscular system of the higher orders of animals is composed of bundles of muscular fibres, and a single muscle is composed of many bundles. They have the property of contracting or of shortening their length by drawing themselves up into wrinkles, or transverse folds. Hence their peculiar fitness for giving motion to the limbs in which they are inserted. It is difficult to get at the primary fibrilles, but they are represented by modern physiologists as being ultimately reducible to globules, similar in appearance to the nervous globules, and not to be distinguished from them except by chemical tests; the muscular globules being soluble in acids, but insoluble in alkalies; and the nervous globules being soluble in alkalies, but insoluble in acids. In the lower orders of animals you have merely rows of muscular globules; yet they are equally available to the purposes of muscular function with the fibres themselves; the former shrinking by condensation, the latter by incurvation.

Such is a brief view of the *nervimotility* of animals, when the impression from without, or the stimulus from within, impels or excites the organs. Let us now see what proofs M. Dutrochet adduces in favor of vegetable *nervimotility*. His first observations were confined chiefly to the movements of the leaflets and petiole of the sensitive plant, which are known to almost every body, as resulting from the slightest touch of the finger, or other instrument applied to them. In this case he found that the tumour at the base of the petiole is the seat of the moving power; for if that is cut away the motion ceases. The upper part of the tumour pulls the petiole up, and the lower part of it pulls the petiole down. This was ascertained by making the experiment, first, with a petiole having the one half of the tumour cut off, and then with a petiole having the other half cut off. Hence the one half of the tumour is the cause of flexion, and the other half the cause of recovery, as in the antagonist or flexor and tensor muscles of animals. Now the tumours of the Mimosa, in the language of Dutrochet, are composed partly of nervous globules, known to be such by their being soluble in alkalies; and partly of rows of muscular globules, known to be such by their being soluble in acids.

Thus, plants, according to Dutrochet, without having real nerves, have the elements of nerves, and, without having real muscles, have the elements of muscles; and their movements are effected, as in the zoophytes and infusory animalcules, if Ehrenberg's discoveries have not negatived the comparison. After a contraction there comes a relaxation—in animals often rapidly; in plants more slowly; except in *Hedysarum gyrans*, in which it is rather quick, or at least not very slow, and in which it is perpetual, as it is in the filaments of the Oscillato-

rias. Yet you may have both flexion and recovery without either bunch or tumour. If the scape of a daffodil is bent down by snow or frost, it recovers itself again when the temperature becomes more mild; or if the stem of a balsam sinks down for lack of moisture till it touches the earth, it recovers itself again, upon the application of plenty of moisture. Still, upon the principles of Dutrochet, the phenomenon is owing to the nervimotility of the plant. For where he has not tumours he attaches the globules to his *Veiscesus corpusculifères*, and makes them efficient, even there, to the purposes of vegetable movement. *

Thus we have endeavoured to exhibit a brief and correct view of M. Dutrochet's theory of nervimotility. We do not know that it has been adopted by any botanist or physiologist of distinction; but as the contrastility in question is evidently vital, it seems to demand and to imply the agency of the causes to which M. Dutrochet attributes it,—not as involving feeling, but merely ganglionic action.

SHEET IRON COFFINS.

ONE of the most singular applications of sheet-iron, which our times have witnessed, and certainly none of the least feasible, has been its use in the construction of that piece of furniture of man's *ultima domus*, which is usually furnished by the undertaker. In the year 1819, a patent was obtained by an individual of the name of Bridgman, for making coffins of rolled iron: this novel introduction of the material was defended as being better calculated than wood for the protection of the bodies therein deposited, from sacrilegious abstraction for anatomical purposes. The reception, however, of these iron coffins into the metropolitan cemeteries was withstood, on the ground that, as they would last much longer than wooden ones, the grave-yards consecrated for the sepulture of the inhabitants of the different parishes would soon become too strait for their accommodation. In order to try the legal validity of this objection, Bridgman, the patentee, made application at the burial ground of St. Andrew's Holborn, to bury the corpse of a woman in an iron coffin: the funeral proceeded to the ground in Gray's Inn Lane, but the interment was withstood by the parish authorities, the coffin deposited in the bone house, and legal proceedings instituted against the churchwardens. This novel case was argued in the consistory court, the most eminent counsel being employed on both sides.

In favor of interment in iron, it was contended, that sepulchral chests were of great antiquity; that coffins of stone and lead, as well as wood, had been, or were, in use in this country from very early times, and that even brick graves were every day allowed to be made in all church-yards throughout the kingdom. The question to be argued, therefore, was one of right, the law not having either specified or prohibited any particular material. On the part of the churchwardens, it was alleged, that the right of the parishioners generally would be greatly infringed by the introduction of iron coffins, as the ground would soon be entirely occupied by them, and, consequently, an act of injustice would be committed. The judge, Sir Wm. Scott, in a luminous summing up, observed, that with reference to precedent it was a well-known fact, that burning the body, and naked inhumation, preceded the use of

coffins of any sort; and that among nations civilised as well as savage: and it was remarkable that in the burial service of the church there was no mention made of a coffin at all. It was asserted by one party, that, in point of absolute duration, the iron coffins would not last longer than wooden ones. The learned judge remarked, that, upon this point, it was not without a violent revolt to all the ideas he had formed on the subject, that he heard it affirmed, that coffins formed of iron would not keep longer possession of the soil than those formed of wood: to him it appeared, without pretending to any experimental knowledge on such subjects, that it must be otherwise; rust was the process by which iron travelled to decomposition; excluded from the air, it remained unimpaired; and if it did from internal moisture, or any small admission of external air, contract rust, that rust, until it scales off, protects the interior parts from further decay; whereas wood corrupts internally, and thus hastens its own destruction. It was ultimately decided that the parish should prepare a table of fees applicable to the reception of iron coffins.

MEMORANDA.

Indestructible Ink.—Take shell lac 4 parts by weight, borax 2 parts, soft water 36 parts. Boil in a close vessel till dissolved, then filter, and take of gum arabic 2 parts, soft water 4 parts. Dissolve and mix the two solutions together, and boil for five minutes as before, occasionally stirring to promote their union. When cold, add a sufficient quantity of finely powdered indigo or lamp-black, according to the color required;—lastly, let it stand for two or three hours, until the coarser powder has subsided, and bottle for use. Use this fluid with a clean pen, and keep it in a glass or earthen inkstand. as many substances will decompose it in a liquid state. When dry, it will resist the action of water, oil, turpentine, alcohol, diluted sulphuric acid, diluted hydrochloric acid, oxalic acid, chlorine, and the caustic alkalis and the alkaline earths. This fluid made in quantity will cost about two shillings a gallon.

QUERIES.

How is the weight of a column of water of any height ascertained? We presume that the pressure of the column is here required. The pressure of fluids is in proportion to the quantity of them. Water a foot high will exert a pressure of nearly half a pound (.434 lb) upon every square inch of the internal surface of the vessel that contains it. If the column be two feet high, it will be double this; and so on for other heights. Other fluids will exert more or less pressure, according to their gravity compared with water.

What is the scarlet color with which fancy papers are stained? We believe that this is derived for the commoner kinds of paper from Brazil wood boiled in water, to which, alum, potass, or muriate of tin is added, according to tint required; about a pound and a half of alum is used for a pound of Brazil wood chips. The finer kinds of paper are washed with carmine or lake, prepared from cochineal dissolved in water. (For the carmine lakes, see Vol. I.)



FORMS AND INDICATIONS OF CLOUDS

FORMS AND INDICATIONS OF CLOUDS.

THE first successful attempt to arrange the diversified forms of clouds under a few general modifications was made by Luke Howard, Esq. We shall give here a brief account of his ingenious classification.

The simple modifications are thus named and defined:—1. Cirrus, a parallel, flexuous, or diverging fibre, extensible in any or in all directions, A.

2. Cumulus, a convex or conical heap, increasing upwards from a horizontal base, B.

3. Stratus, a widely-extended, continuous, horizontal sheet, increasing from below, C.

The intermediate modifications which require to be noticed are, 4. Cirro-cumuli, small, well-defined, roundish masses, in close horizontal arrangement, D. 5. Cirro-strata, horizontal, or slightly-inclined masses, attenuated towards a part or the whole of their circumference, bent downward or undulated, separate, or in groups consisting of small clouds having these characters, E.

The compound modifications are, 6. Cumulo-stratus, or twain cloud; the cirro-stratus blended with the cumulus, and either appearing intermixed with the heaps of the latter, or superadding a wide-spread structure to its base, F. 7. Cumulo-cirro-stratus, or Nimbus; the rain-cloud, a cloud or system of clouds from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus enters it laterally and from beneath, G. 8. The Fall Cloud, resting apparently on the surface of the ground, H.

The cirrus appears to have the least density, the greatest elevation, the greatest variety of extent and direction, and to appear earliest in serene weather, being indicated by a few threads, pencilled on the sky. Before storms, these threads appear lower and denser, and usually in the quarter opposite to that from which the storm arises. Steady high winds are also preceded and attended by cirrous streaks, running quite across the sky, according to the direction in which they blow.

The cumulus has the densest structure, is formed in the lower atmosphere, and moves along with the current next the earth. A small irregular spot first appears, and is, as it were, the nucleus on which the cumuli increase. The lower surface continues irregularly plane, while the upper rises into conical or hemispherical heaps, which may afterwards continue long nearly of the same bulk, or rapidly rise into mountains. They will begin, in fair weather, to form some hours after sunrise, arrive at their maximum in the hottest part of the afternoon, then begin to diminish, and totally disperse about sunset. Previously to rain, the cumulus increases rapidly, appears lower in the atmosphere, and with its surface full of loose fleeces or protuberances. The formation of large cumuli, to leeward, in a strong wind, indicates the approach of a calm, with rain. When they do not disappear or subside about sunset, but continue to rise, thunder is to be expected in the night.

The stratus has a mean degree of density, and is the lowest of clouds, its inferior surface commonly resting on the earth or water. This is properly the cloud of night, appearing about sunset. It comprehends all these creeping mists which, in calm weather, ascend in spreading sheets (like an inundation of water) from the bottoms of vallies and the surfaces of lakes and rivers. On the return of the sun, the level surface of this cloud begins to put on

the appearance of cumulus, the whole at the same time separating from the ground. The continuity is next destroyed, and the cloud ascends and evaporates, or passes off with the appearance of the nascent cumulus. This has long been experienced as a prognostic of fair weather.

Transition of forms.—The cirrus, having continued for some time increasing or stationary, usually passes either to the cirro-cumulus or the cirro-stratus, at the same time descending to a lower station in the atmosphere. This modification forms a very beautiful sky, and is frequently, in summer, an attendant on warm and dry weather. The cirro-stratus, when seen in the distance, frequently gives the idea of shoals of fish. It precedes wind and rain; is seen in the intervals of storms; and sometimes alternates with the cirro-cumulus in the same cloud, when the different evolutions form a curious spectacle. A judgment may be formed of the weather likely to ensue, by observing which modification prevails at last. The solar and lunar haloes, as well as the parhelion and paraselene (mock sun and mock moon), prognostics of foul weather, are occasioned by this cloud. The cumulo-stratus precedes, and the nimbus accompanies rain.

CLASSIFICATIONS OF THE METALS.

WHAT is a metal? and how shall I define the members of this extensive class of bodies, containing forty-two of the fifty-five substances known to chemists, and regarded by them as elementary?—are two questions which must suggest themselves to the consideration of every inquiring person engaged in the fascinating and enticing study of chemistry—or arise in the mind of any one who is desirous of making use of a term, of which, when requested, he feels himself incapable of giving a correct explanation.

We should do well did we more frequently allow ourselves on commencing any science to look back upon its past history, and aided by that light which its present advanced state might afford us, watch carefully how gradually its followers, emerging from the darkness of error, and assisted by each new discovery, have thrown off from time to time some fresh portion of that veil which had so long obscured their progress, and approached nearer and nearer towards the attainment of truth. The historical method of conveying information has always been considered the best wherever it is at all applicable; since by it we are enabled to present our information to the mind of the student, precisely in the same order as man first acquired it.

It is true that men are too apt to pass over the history of a science in their eagerness to become acquainted with its more confirmed truths, and to feel some distaste for diving deeply into what may turn out to be only a catalogue of many idle theories, each of which however has in its turn held a longer or shorter sway in the minds of its supporters, until at length shown to have had but little other foundation than in their own imaginations, has been doomed to share a common fate with that which had preceded it. Although wherever applicable this plan is the most valuable one we can pursue, yet it must be acknowledged, that there are but few studies in which we can take advantage of it; most certain it is, that were it more generally adopted, it would do much towards obviating the monotony of the lecture-room, and often form a very good outline for the general plan of a discourse

Now if we apply this sort of retrospective investigation to the subject under consideration, we shall find that, not many years ago, chemists were in the habit of declaring that metals might be distinguished from all other bodies by the following properties. Solidity with a peculiar brightness denominated metallic lustre, opacity, fixidity by heat, great specific gravity, and a sufficient cohesion among their particles to allow their being extended in various ways, so as to become either malleable, ductile, or laminable. Supposing we were to assume this as our standard definition, we might soon find some few substances not usually called metallic, yet agreeing in a very great many of the particulars here enumerated, and if we were likewise to reflect, that even many of the bodies of which these terms were intended to be characteristic, do not themselves possess all these properties, we might feel induced to include them also in the same class. For of these six properties, iodine possesses three, namely,—solidity, metallic lustre, and opacity; and mercury has but three, metallic lustre, opacity, and specific gravity. How is it then we might ask that the one has always been considered a metal while the other has never been so designated? If the whole six properties were equally essential to a metal, surely the term ought not to have been denied any more to the one than to the other. The rapid advance of science soon proved that this was far from a correct definition, and to make it at all suitable many other ingredients required to be added.

As the voltaic battery showed that great specific gravity ought no longer to be accounted such a distinguishing peculiarity of these bodies as it had previously been considered, so it supplied us with a new test for their detection, inasmuch as it was found, that whenever any of these compounds suffered decomposition before its powerful influence, they invariably appeared at the negative pole; hence arose this new and important attribute, that substances of this description must belong to what was styled the electro-positive class of elements. The discovery that certain rays of light might be transmitted through one of these bodies, when reduced to an exceedingly attenuated state, would lead us to imagine, that opacity depends more upon the close approximation of their particles, than any property especially possessed by them, and to expect that could this be overcome in other metals besides gold, we might show that they are also to a certain amount translucent. The discovery too of other metals than mercury, capable of being dissipated by distillation, proved that fixidity at high temperatures ought no more to be regarded as a constant property than opacity. Writers on chemistry perceiving how difficult it is to frame any single definition which shall include all these bodies now, content themselves by giving a lengthened description of their general physical properties, mentioning the exceptions as they proceed—from which it would appear that they can scarcely assign any one property except their good conductivity of heat and electricity, to which they are not obliged to append some exceptions. Take, for example, the sketch given of the physical properties of metals in Graham's recent work on chemistry, which I believe to be the latest and best authority on the subject in our language, and you will observe that such is decidedly the case. In the first column of the subjoined table, these various properties are arranged in the same order as they follow each other in the text; and opposite to each of them are placed the exceptions, with

such additions as appeared appropriate. Iodine is merely put opposite metallic lustre to remind us in what an eminent degree it exhibits this property, although devoid of others much more essential to constitute it a metal.

PROPERTIES.	EXCEPTIONS.
Metallic lustre.	Iodine.
Opacity	Gold-leaf—i. e. when in an highly attenuated state.
Conductibility of heat and electricity . . .	Tellurium is an indifferent conductor of both, and platinum of heat.
Great specific gravity	Potassium and sodium.
Malleability	Arsenic, antimony, and bismuth.
Ductility	The same.
Capability of being welded.	All, except iron and platinum at a red heat, and potassium, and perhaps a few others at the ordinary temperature.
Solidity	Mercury.
Disposition to combine spontaneously with oxygen	Silver, palladium, platinum, and gold.

Would it not be better then to banish the word metal entirely from chemical language, and when speaking either of iron, copper, or silver, to view them as much as elements and no more; as oxygen, hydrogen, or chlorine; and if we must have some form of classification, let it be founded on some other more certain and more stable basis.

The doctrine of isomorphism seems to afford this desired method, and evinces the utter absurdity and futility of attempting to draw any marked distinction between a metallic and non-metallic element. For in the first class of this mode of arrangement, we find tellurium ranked with oxygen; in the second hydrogen placed between copper and bismuth, and in the sixth nitrogen, by the side of arsenic and antimony. There is however one point which is of the highest importance the student in chemistry should never for a moment allow himself to be slight of; it is that he should always remember that the terms "simple body" and "simple element" are purely conditional. When we assert that carbon is a simple body, all we intend is, that as far as our present limited powers of analysis will conduct us, we cannot succeed in resolving it into any other more simple form; but we are perfectly willing to admit, and indeed ardently hope, that the day is not far distant, when we shall no longer consider such to be the case, when by the assistance of some new and more powerful agent than we have yet been able to make use of, or by following some new plan of investigation, perhaps yet not so much as even pointed out, we may demonstrate the correctness of this supposition, or at least should it not hold good in this particular instance, may nevertheless diminish the existing list of elementary bodies, and thus by removing many obstacles improve the path of discovery, which we must leave to be trod by our successors.

Chemists prior to the year 1807, when the illustrious Davy first taught his fellow-laborers to seek the help of electricity in effecting decompositions before presumed to be impracticable, were just as much justified in viewing soda and potash as simple bodies, (provided they used the term in its proper signification,) as we in the present day in admitting iron, or even any of the precious metals to be elementary. Seeing that isomorphism presents such

a fair prospect of benefit to chemical science, let us direct all our attention towards becoming better acquainted with its principles; it has already done much, but I need not add, there is still much for it to do. Perhaps it is from the united assistance of isomorphism and isomerism, that we have a right to expect to derive the greatest advantage: when we have proved that the combinations of two bodies are in all respects isomorphous; the next step would appear to show that the primary bodies themselves are isomeric. In the case of arsenic and phosphorus we can hardly divest ourselves of the idea that such must be the case. Whether then considering that thus far we have been unable to give any direct proof of the truth of this conjecture, we should fall back disheartened at this early failure, or proceed onwards with our task with renewed energy and more fixed determination never to desist until successful, are considerations I must leave to be decided by the taste and the enthusiasm of the student in this branch of science. E. L.

Faversham, Kent.

[Isomorphism here spoken of is explained in our first volume. Our correspondent is evidently a man of information, yet in his paper he has but shown the difficulties of describing a simple idea, difficulties which are insuperable in simple ideas of all kinds; for example—Who can describe a color to the blind? or a sound to the deaf? Who can show the minute shades intervening between the animal, vegetable, and mineral kingdoms, or even between the various classes of each of these kingdoms? So also with metals, chemically speaking it is very difficult to show the exact limits which they occupy; yet they are popularly well-known, and any definition of them must be considered as instituted merely for the sake of convenience, and facility of reference, nor is it probable that it will ever be otherwise. We may find a metallic base for alumina and for silica, but if we do, the latter can never be classed with the rest of the metals in general properties, and if, as is probable, that we may discover a metallic base for some of what are now considered non-metallic elements, still the difficulties would increase rather than diminish. Therefore, notwithstanding the desirableness of precision of scientific language and classification, we despair of its ever being fixed, as new trains of experiment, by unfolding new facts and new ideas, disturb those previously adopted, and require a constant change. Our correspondent seems to think that the metals are not simple bodies, or at any rate that we have no right to insist upon it that they are so; this is true, yet all the experiments of late years, by the ablest chemists, and with the mightiest powers of nature that we are acquainted with, have had a tendency to prove other bodies not previously considered so to be metallic, while there is not one metal of any kind which has been in the smallest degree decomposed, therefore we are bound to suppose them ultimate elements of nature; yet we may by a well-grounded inference imagine carbon, selenium, silicium, boron, iodine, and indeed all solids to have a metallic base, although the present state of knowledge cannot ascertain the fact. Should this ever be proved the definition of a metal would be an elementary solid, while the definition of the only other bodies then remaining, oxygen, hydrogen, nitrogen, and chlorine, would be an elementary gas or liquid; but perhaps we may never attain to such a degree of precision, and if we did, still the subdivisions would be as difficult as the primary divisions of matter are now.—ED.]

TRANSMISSION OF HEAT.

The transmission of radiant heat is analogous to that of light through colored media. When common white light, consisting of blue, yellow, and red rays, passes through a red liquid, almost all the blue and yellow rays, and a few of the red, are intercepted by the first layer of the fluid; fewer are intercepted by the second, still less by the third, and so on; till at last the losses become very small and invariable, and those rays alone are transmitted which give the red color to the liquid. In a similar manner, when plates of the same thickness of any substance, such as glass, are exposed to an Argand lamp, a considerable portion of the radiant heat is arrested by the first plate, a less portion by the second, still less by the third, and so on; the quantity of lost heat decreasing till at last the loss becomes a constant quantity. The transmission of radiant heat through a solid mass follows the same law. The losses are very considerable on first entering it, but they rapidly diminish in proportion as the heat penetrates deeper, and become constant at a certain depth. Indeed, the only difference between the transmission of radiant heat through a solid mass, or through the same mass when cut into plates of equal thickness, arises from the small quantity of heat that is reflected at the surface of the plates. It is evident, therefore, that the heat gradually lost is not intercepted at the surface, but absorbed in the interior of the substance, and that heat which has passed through one stratum of air experiences a less absorption in each of the succeeding strata, and may therefore be propagated to a greater distance before it is extinguished. The experiments of M. de Laroche show that glass, however thin, totally intercepts the opaque rays of caloric when they flow from a body whose temperature is lower than that of boiling water; that, as the temperature increases, the caloric rays are transmitted more and more abundantly; and when the body becomes highly luminous, that they penetrate the glass with perfect ease. The extreme brilliancy of the sun is probably the reason why his heat, when brought to a focus by a lens, is more intense than any that has been produced artificially. It is owing to the same cause that glass screens, which entirely exclude the heat of a common fire, are permeable by the solar caloric.

The results obtained by M. De Laroche have been confirmed by the recent experiments of M. Melloni on caloric radiated from sources of different temperatures, whence it appears that the caloric rays pass less abundantly, not only through glass, but through rock-crystal, Iceland-spar, and other diaphanous bodies, both solid and liquid, according as the temperature of their origin is diminished, and that they are altogether intercepted when the temperature is about that of boiling water. In fact, he has proved that the heat emanating from the sun, or from a bright flame, consists of rays which differ from each other as much as the red, yellow, and blue rays do which constitute white light. This explains the reason of the losses of heat as it penetrates deeper and deeper into a solid mass, or in passing through a series of plates; for, of the different kinds of rays which dart from a vivid flame, all are successively extinguished by the absorbing nature of the substance through which they pass, till those homogeneous rays remain which have the greatest facility in passing through that particular substance; exactly as in a red liquid the blue and yellow rays are extinguished, and the red are transmitted.

M. Melloni employed four sources of caloric, two of which were luminous, and two obscure; namely, an oil lamp without a glass, incandescent platina, copper heated to 696° , and a copper vessel filled with water at the temperature of $178\frac{1}{2}^{\circ}$ of Fahr. Rock-salt transmitted heat in the proportion of 92 rays out of 100 from each of these sources; but all other substances pervious to radiant heat, whether solid or liquid, transmitted more caloric from sources of high temperature than from such as are low. For instance, limpid and colorless fluato of lime transmitted in the proportion of 78 rays out of 100 from the lamp, 69 from the platina, 42 from the copper, and 33 from the hot water; while transparent rock-crystal transmitted 38 rays in 100 from the lamp, 28 from the platina, 6 from the copper, and 9 from the hot water. Pure ice transmitted only in the proportion of 6 rays in the 100 from the lamp, and entirely excluded those from the other three sources. Out of 39 different substances, 54 were pervious to the caloric rays from hot water, 14 excluded those from the hot copper, and 4 did not transmit those from the platina.

Thus it appears that heat proceeding from these four sources is of different kinds: this difference in the nature of the caloric rays is also proved by another experiment, which will be more easily understood from the analogy of light. * Red light, emanating from red glass, will pass in abundance through another piece of red glass, but it will be absorbed by green glass: green rays will more readily pass through a green medium than through one of any other color. This holds with regard to all colors; so in heat. Rays of caloric of the same intensity, which have passed through different substances, are transmitted in different quantities by the same piece of alum, and are sometimes stopped altogether; showing that rays which emanate from different substances possess different qualities. It appears that a bright flame furnishes rays of heat of all kinds, in the same manner as it gives light of all colors; and as colored media transmit some colored rays and absorb the rest, so bodies transmit some rays of caloric and exclude the others. Rock-salt alone resembles colorless transparent media in transmitting all kinds of caloric, even the heat of the hand, just as they transmit white light, consisting of rays of all colors.

The property of transmitting the caloric rays diminishes, to a certain degree, with the thickness of the body they have to traverse, but not so much as might be expected. A piece of very transparent alum transmitted three or four times less radiant heat from the flame of a lamp than a piece of nearly opaque quartz about a hundred times as thick. However, the influence of thickness upon the phenomena of transmission increases with the decrease of temperature in the origin of the rays, and becomes very great when that temperature is low. This is a circumstance intimately connected with the law established by M. De Laroche; for M. Melloni observed that the differences between the quantities of caloric transmitted by the same plate of glass, exposed successively to several sources of heat, diminished with the thinness of the plate, and vanished altogether at a certain limit; and that a film of mica transmitted the same quantity of caloric, whether it was exposed to incandescent platina or to a mass of iron heated to 360° .

Colored glasses transmit rays of light of certain degree of refrangibility, and absorb those of other degrees. For example, red glass absorbs the more

refrangible rays, and transmits the red, which are the least refrangible. On the contrary, violet glass absorbs the least refrangible, and transmits the violet, which are the most refrangible. Now M. Melloni has found, that although the coloring matter of glass diminishes its power of transmitting heat, yet red, orange, yellow, blue, violet, and white glass transmit caloric rays of all degrees of refrangibility. Whereas green glass possesses the peculiar property of transmitting the least refrangible caloric rays, and stopping those that are most refrangible. It has, therefore, the same elective action for heat that colored glass has for light, and its action on heat is analogous to that of red glass on light. Alum, and sulphate of lime, are exactly opposed to green glass in their action on heat, by transmitting the most refrangible rays with the greatest facility. The heat which has already passed through green or opaque black glass will not pass through alum, whilst that which has been transmitted through glasses of other colors traverses it readily. By reversing the experiment, and exposing different substances to caloric that had already passed through alum, M. Melloni found that the heat emerging from alum is almost totally intercepted by opaque substances, and is abundantly transmitted by all such as are transparent and colorless, and that it suffers no appreciable loss when the thickness of the plate is varied within certain limits. The properties of the heat, therefore, which issues from alum, nearly approach to those of light and solar heat.

ANCIENT DOMESTIC ARCHITECTURE.

THERE is ample evidence yet remaining of the domestic architecture in this country during the twelfth century. The arrangement of the ordinary manor house, and even of houses of greater consideration, appears to have been generally a building in form a parallelogram, two stories high, the lower story vaulted, no internal communication between the two, the upper story approached by a flight of steps on the outside, and in that story was sometimes the only fire-place in the whole building. It is more than probable that this was the usual style of house in the preceding century, as in the Bayeux tapestry is the representation of a house having all these features, except the fire-place. The manor house at Boothby Pagnel, Lincolnshire, is a perfect specimen of such a house, its date rather late in the twelfth century; it had a sort of moat not washing the walls: at Christchurch, Hants, is another house rather earlier. The Jews' house at Lincoln seems to have been also on this plan, the fire-place being in the upper story; so another house near it; and the Guild there, commonly called John of Gaunt's Stables, appears to have had a fire-place in the upper story; in which story in all these buildings (where that story exists) are the larger windows, those below being small narrow lights. Moyses' Hall at Bury St. Edmund's is a larger and later building, consisting of two portions, but still, so far as it can be traced, on the same plan. At Canterbury there yet remains a covered flight of steps to an upper story, supposed to be the only one of this age now in existence: the roof is supported by a series of richly ornamented semi-circular arches on slender shafts. The building this flight led to is now destroyed: it was called the Stranger's Hall or Treasury.

There were however in the twelfth century, other houses on a different plan, having a hall on the

ground-floor, which went the whole height of the house; thus at Barnack was such a hall, divided into three parts by columns and arches like a church: at Oakham Castle, Rutland, is a similar hall, which is all that now remains of the original structure built by Walcheline de Ferrers about 1180. The greater part of the palace of the bishop of Hereford appears to have been originally a hall on this plan, having the columns and arches of timber. In a garden at Warnford in Hampshire are two rows of very lofty octagonal columns of the latter part of the twelfth century, which appear to have supported the roof of a hall, and from their great height probably did so without intervening arches. It is not unlikely that Westminster Hall, as originally built by William Rufus, from its great width so arranged, and the roof thus supported: at a later period there occur occasional instances of a similar plan.

The square-headed window early appears, for it occurs divided by a mullion, under a semi-circular arch at Moyses' Hall. Instances also are found in this century of a fashion which continued much later, seats are formed on each side of the window in the interior, by cutting down the wall, or rather by not building it up all the way to the window-sill, leaving a bench of stone on each side. Various parts might be picked out of remains of religious houses, and in many places single doorways remain of this age. The castles at this period had also their entrance on the first floor by a flight of steps, as at Rochester. At Temple Bruer, Lincolnshire, remains the square tower (late Norman), originally joined to the round church, which is now destroyed; this tower was the residence or part of the residence of the Knights Templars.

In the early part of the thirteenth century the general plan of house before spoken of was still continued, and of this Pythagoras's School at Cambridge, and the Temple Farm, Strood, Kent, (the latter to be disentangled from modern work,) are specimens; and there are other buildings of about the same date of the same kind. There has been a difficulty in finding even a tolerably perfect house during the latter half of this century, and the cause is probably this; so long as the house was a simple parallelogram, the original building is easily distinguished among later additions, but when increasing wants changed the plan to one more complicated, the original plan would be more difficult to detect amidst subsequent alterations. There is however a good example in Aydon Castle, Northumberland, the date of which is rather late in the thirteenth century, and the building is, except as to some of the offices, in a wonderfully perfect state: though called a castle, it is merely a house built with some attention to security. The general plan is a long irregular line, with two rather extensive inclosures or courts formed by walls, besides one smaller one within. On two sides is a steep ravine, on the others the outer wall has a kind of ditch, but very shallow. The original chief entrance is yet by an external flight of steps which had a covered roof to the upper story, and so far partaking of the features of the earlier houses: it contains at least four original fire-places. Some of the windows are square-headed with two lights.

Early in the fourteenth century comes Markenfield Hall, Yorkshire, on a plan not very unlike Aydon, and mostly very perfect; but here the entrance was on the ground: the lower story partly vaulted, and the chief rooms still up stairs: it has a turret staircase, and there are square-headed two-

light windows, with a transom, a large irregular court formed partly by the house, partly by stables and other outbuildings, surrounded by a moat, which is scarcely more than a ditch. The windows, which are square-headed, are evidently made so from necessity, the floor above or the roof not allowing space for an arch. Where there is space the windows are arched. Perhaps late in the preceding, and certainly early in this century, houses are to be found which (it may be presumed for safety) have a square tower attached to them. Longthorpe near Peterborough is one of these, and the tower, though later in detail, has many features in common with that at Temple Bruer, before mentioned. There was such a tower at Nursted Court, Kent; and in the same county the older part of the building called Stone Castle is probably such a tower.

The domestic remains during this century are very numerous, and the plans very various, probably some of them originally quadrangular within moats, but we are not aware of any quadrangular building which has all its sides of the fourteenth century; the nearest to it is perhaps the Mote, Ightham, Kent. The hall is a very chief feature in the houses of this date, and that at the Mote, Ightham, is very perfect, and is also valuable because it explains the mode in which the roof was placed on the hall of the archbishop's palace at Mayfield, Sussex, which has at present only the two stone arches which supported it remaining. There appears to have been the same kind of roof at Battle Hall, in Leeds, Kent. It usually happens, however, that the hall of houses during this century has in recent days been subdivided by modern floors, and the external features alone remain, as at Northborough, Northamptonshire, and many other places. Part of Battle Hall still retains the original plan of house, (if the term may be used), as in one part of the house, at the east end of the hall, is a dark vaulted room, or almost cellar, and over it a sort of principal chamber with a fire-place, this portion is of no greater age than the rest of the building. Having already mentioned roofs, mention must be made of that of the hall at Nursted Court, Kent; it was so framed as to stand about four feet within the walls, and formed, by the two timber columns on which it rested, two small side aisles and a centre, so far in plan like the earlier Norman halls of Barnack and Oakham.

(To be continued.)

BLEACHING.

(Resumed from page 157, and concluded.)

Steam Bleaching.—The compressed steam of boiling alkaline leys, was some time ago recommended for the purposes of bleaching, by Chaptal, chiefly for cotton goods. They are continually and repeatedly immersed in alkaline ley, made in the usual manner, and then exposed to the action of the vapor arising from the same ley, heated to 220° or 230° Fahr. By this means the French chemists, Chaptal and Delametherie, procured good whites, without injury to the fabric of the cloth, and without using any preparation of chlorine. They found that the resinous, and other coloring matters of the cloth, which are insoluble in a diluted ley of the temperature of boiling water, becomes soluble in the vapor of the same, when the heat is carried a few degrees farther. The immersion of the goods in the ley, and subsequent exposure to its vapor, are successively repeated, till the goods become

completely white. Chaptal performed an extensive experiment on the same principle, in order to introduce it for domestic washing. He washed by this method, with great success, 200 pairs of sheets belonging to the Hotel Dieu at Paris. In giving an account of this Mr. Parkes observes, that brown calicoes, which have only been *once* boiled, after having been all night in the wash-boller, are often completely white, where they have been in immediate contact with the iron in the midst of the apparatus, while the other parts were almost unchanged. The process of steam bleaching, the same author remarks, will always be attended with danger, as the force of the steam, if the valves be overloaded, or deranged, may burst the apparatus. It seems to be but a slight modification of the French process, for which Mr. Turnbull of Bonhill obtained a patent. He immerses his goods, either cotton or linen, in a hot solution of caustic alkali, and then exposes them to the vapor of simple water, when loaded with the alkali in which they have been immersed. The previous and subsequent processes are the same as in the ordinary mode, and the chief advantage of this plan seems to be in the saving of alkali, much fewer baths of ley being necessary than in the common method, as the heated vapor increases the alkaline action. It does not however supersede the chlorine preparations, at least, good whites cannot easily be procured without immersion in a chloride.

Paper Bleaching.—This title comprehends two different processes: one for bleaching rags, and other materials from which paper is at first fabricated, and another for refabricating paper from old written or painted papers. We are chiefly indebted to the French chemists for these processes, which may be seen in various parts of the *Annales de Chimie*, and in *Des Charmes' Art of Bleaching*. Rags, when grey or colored, are to be separated and ground in the paper-mill in the usual way, till brought to a sort of uniform consistence, having been previously macerated according to their quantity and tenacity. The mass is then treated with an alkaline ley, similar to what has already been directed for piece goods. It is next treated with any of the preparations of chlorine, which is thought most convenient. We believe the chloride of potash, which was lately the most common, has now given place in Britain to the chloride of lime. If this immersion do not produce the desired effect, which does not often happen if the colors are tenacious, such as red and blue, let the treatment with the alkaline leys be repeated, and follow it with another bath of the chlorine preparation. Then sour the whole in a bath of sulphuric acid, much diluted and cold, for when hot its action will be less effectual. Water is then to be run upon it till it come off without color or indication of acidity. Black is the most easily discharged color, and will seldom require being treated with ley or steep of sulphuric acid, one bath of alkali and another of chloride of lime being sufficient to produce a good white. Old printed or written paper again is first to be sorted according to its quality, and all the yellow edges cut off by the bookbinder's plane. One hundred weight of this paper is to be put sheet by sheet into vats sufficiently capacious, with 500 quarts of hot water. The whole is to be stirred for about an hour, and as much water gradually added as will rise about three inches above the paper, and to be left to macerate for four or five hours. It is then ground coarsely in the mill, and boiled in water for about an hour, taking care to add before it begins to boil, thirteen

quarts of caustic alkaline ley. After boiling, it is macerated in the ley for twelve hours, when it is pressed, and if sufficiently white is forthwith manufactured into paper; if not, the process is repeated. Written paper may be bleached by sulphuric acid alone, and printed paper by alkaline or soap leys, but the above process is the most effectual, and the expense is exceedingly trifling. Paper which has been written or printed may even be bleached without destroying the leaves, by treating them with the same chemical agents, taking care to arrange the sheets alternately between cloths in the same manner as the paper makers dispose their sheets of paper when delivered from the form.

Straw Bleaching.—Our milliners not pleased with the yellow color, which the straw of which hats are made originally, possesses, or urged by the all-prevailing taste, have lately been desirous of obtaining white straw; and several attempts have been made to bleach this substance with the usual agents. Sulphuric acid has been found to succeed best in those incipient attempts while the chlorides and the simple chlorine gas are said to injure the texture and destroy the natural varnish of the straw, which is its greatest beauty. It is probable, however, that this has proceeded from unskilful management, for in other departments of bleaching, the corrosive effects of the chlorine when combined with earths or alkalies, and properly diluted, are found to be as easily prevented as that of sulphuric acid, while its power of destroying a color is greatly superior.

Silk Bleaching.—In Hindostan, as we learn from Dr. F. Buchanan, in his journey through the Mysore (vol. i. p. 223,) in order to bleach their silks, the inhabitants take 5 seers (a seer is 4835 lbs.) of silk, either raw or in thread, 3 seers of *soulu*, or carbonate of soda, and one and a half of quick lime, mixing the soda and lime with 4 or 5 seers of water. This is boiled for an hour, and the silk dipped into it, and afterwards dried. Then they take 3 seers of this silk, 3 seers of *soulu*, one *dudu* (6.47 dra.) of indigo, and 18 seers of water, and boil the whole for about two hours. The silk is then washed in limpid and hot water, and dried. This process requires much care, as if there be too little soda the goods will be spoiled, and if boiled too little a good white will not be produced.

The Chinese mode of bleaching the silk denominated Nankin, without boiling or ungumming it, is supposed to have been discovered by M. Baume, who has given an elaborate memoir on the subject, *Jour. de Phys.* 1793. M. Baume directs to dispose six pounds of yellow raw silk in a stone ware vessel, and to pour over it a mixture previously made of about 48 pints of spirits of wine, and 12 ounces of very pure hydrochloric acid, the whole being then covered up and left to digest, till the liquor change from green to yellowish brown. The liquid is then drawn off, and unaltered spirits of wine is poured upon the silk till it come off colorless; it is then allowed to drain when it is ready for a repetition of the process. The second steeping continues longer than the first. The third maceration is made in pure spirits of wine for a day, when it is drained and sprinkled with water to recover all the spirit; it is then washed clear of the acid by putting it in a woollen bag, and keeping it in a running stream for six hours. The water and the hydrochloric acid ought to be completely free from the nitric acid, otherwise the goods will be spoiled. Rigand found the process to be one half speedier when the vessels were exposed to the sun.

When the silk is to be deprived of its gum, the process is different. A ley of white soap is made by boiling in water 30 lbs. of soap for every 100 lbs. of silk intended to be bleached, and in this the silk is steeped till the gum is dissolved and separated. It is then put into bags of coarse cloth and boiled in a similar ley for an hour. By these processes it loses 25 per cent. of its original weight. The silk is then thoroughly washed and steeped in a hot ley composed of 1 pound and a half of soap, 90 gallons of water, with a small quantity of litmus and indigo diffused. After this it is carried to the sulphuring room: 2 pounds of sulphur are sufficient for 100 lbs. of silk. When these processes are not sufficiently successful, it is washed with clear hard water and sulphured again.

Wool Bleaching.—Wool is commonly bleached by means of fumes arising from the slow combustion of sulphur, by which is meant combustion in the atmosphere in contradistinction to that of burning in oxygen gas, or by a mixture of nitre. The former, Scheele has shown by luminous experiments, is the most effectual for bleaching wool. The process has been known and practised these sixteen hundred years, as appears from Apuleius. It is even mentioned by Pliny to have been employed so early as the first century. The wool is first prepared according to the purposes for which it is intended, by treating it with solutions of soap. By this process, it is cleared of a great quantity of loose impurity and grease which is always found in wool, often losing no less than 70 per cent. of its weight. The heat of the ley must be carefully attended to, as a high temperature is found to fix the unctuous matter or yolk of the wool. After washing, it is taken to the sulphur chamber, where it is exposed to the vapour from 5 to 20 hours according to circumstances. This is again washed, and then immersed in a bath composed of pure whiting and blue. It is then exposed a second time to the fumes of the sulphur, and washed with a solution of soap which renders it of the proper whiteness. It is of importance to remark, that there should be no iron about the sulphur chamber, as by becoming oxidized, it might spot the goods. The cloth of wool also which has been sulphured, ought not to be laid immediately on wood, as the sulphur will dissolve the resin or gum of the wood, and produce stains. The final washing with soap takes away the harshness of the wool and the disagreeable odour left in it by the sulphur. This mode of bleaching, however, only whitens the surface of the goods, which has led recently to the employment of liquid sulphurous acid.

Wax Bleaching.—According to Fourcroy, wax derives its yellow color from the fumes and moisture which proceed from the hives of the bees in the hive as well as from the coloring matter of the vegetables whence it is derived. The opinion seems to have been formed upon the erroneous notion that wax is derived entirely from pollen, the falseness of which by the experiments of Huberson has been completely exposed. It is a pure animal secretion. In order to bleach it, pieces of it are melted so as to fall upon a cylinder which is half dipped in cold water, and which, as it rolls by a simple contrivance, it passes successively through this water. The wax is by this means formed into thin ribbons, which are exposed to the sun and air upon cloths, till it acquire the requisite whiteness, when it is improperly called virgin wax. This is the account given by Fourcroy as

the French method: Parkes has copied it nearly verbatim, as the method followed in England. We have a different account of the French mode in *Des Charmes*: The ribbons of wax he directs to be exposed to the action of water, impregnated with chlorine gas, which succeeds better than any of the chlorides.

We have in the *Annals de Chimie* a very curious account by M. Cadet of the mode of bleaching the vegetable wax produced from the *Myrica cerifera* of America. It is effected by the sulphuric acid or chlorine; but as the wax does not sink in those fluids, means have to be invented to multiply the contact either by cutting the wax into slices, and be-sprinkling it with the liquids, or shutting it up, when sliced, in a cask into which they are introduced. A speedier method would be to place the wax cut into small pieces in alternate strata with the chloride of lime, leaving it in this state for some time dry and in contact. The salt and acidulous water are then to be decomposed by sulphuric acid, pouring in the water gradually, till no more chlorine be disengaged. Add then a large quantity of water, stir the mixture, and the insoluble sulphate of lime will fall to the bottom, while the bleached wax will float on the surface.

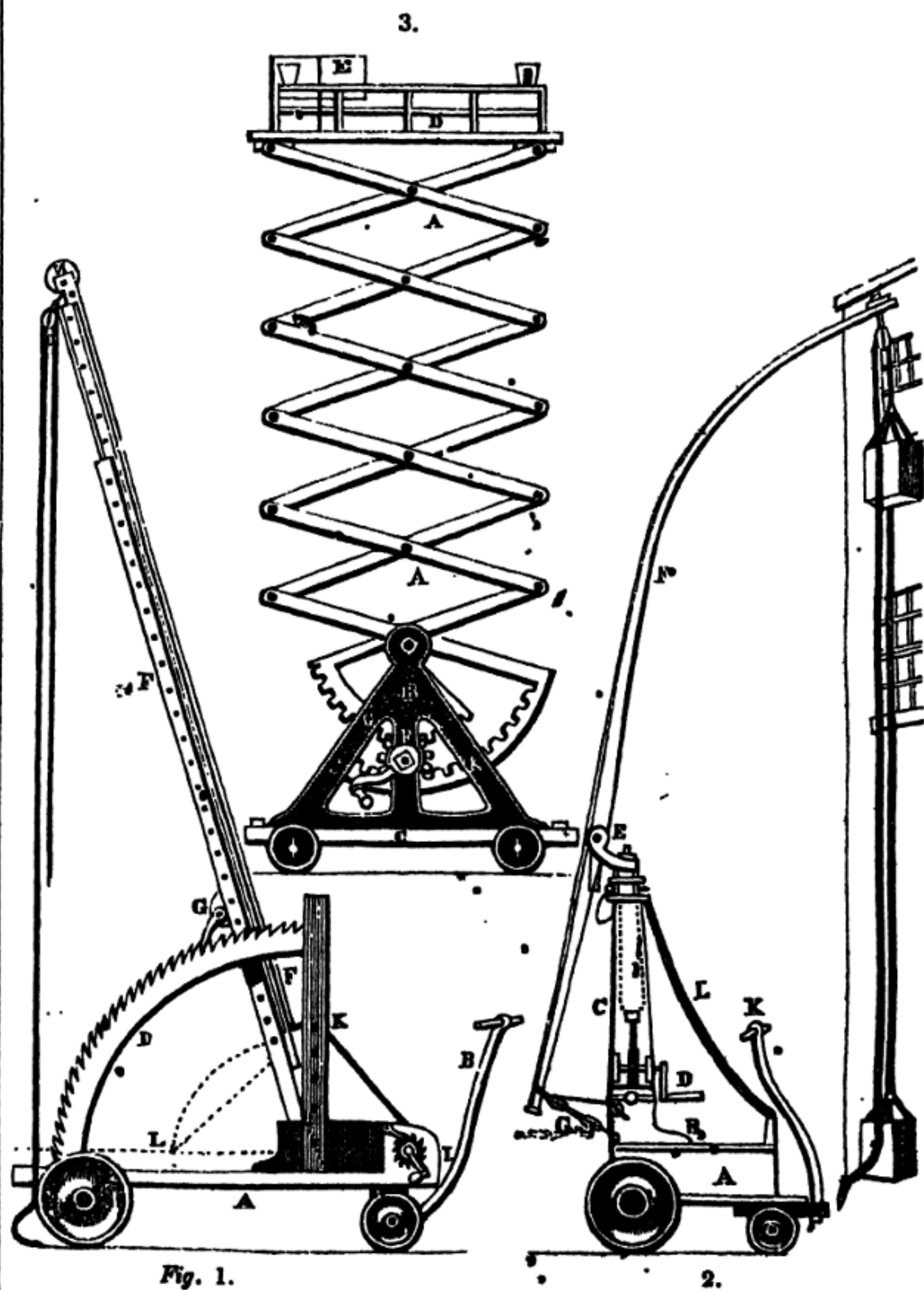
MISCELLANIES.

Bursting a Hogshead.—It is justly affirmed by some writers on natural philosophy, that a certain quantity of water, however small, may be rendered capable of exerting a force equal to any assignable one, by increasing the height of the column and diminishing the base on which it presses. Dr. Goldsmith observes, that he has seen a strong hogshead split in this manner. A small but strong tube of tin, twenty feet high, was inserted in the bung-hole of the hogshead. Water was then poured into the tube till the hogshead was filled, and the water had reached within a foot of the top of the tin tube. By the pressure of this column of water, the hogshead burst with incredible force, and the water was scattered in every direction.

Gold Leaf.—It requires three hundred thousand of such gold leaves as are commonly used in gilding to make an inch in thickness. The tenuity of gold leaf is so great that it is, in some measure, transparent. When it is interposed between the eye and external objects, they are distinctly perceived, of a greenish color.

Large and Small Horses.—Animals draw by their weight, and not by the force of their muscles. The hind feet form the fulcrum of the lever, by which their weight acts against the load, and the power exerted is always proportioned to the length of the lever, the weight remaining the same. Large animals, therefore, and other animals, draw more than small ones, even though they have less muscular force, and are unable to carry such a heavy burden. The force of the muscles tends only to make the horse carry continually forward his centre of gravity, or, in other words, the weight of the animal produces the draught, and the play and force of its muscles serve to continue it.

Singular Property of the Balance.—The following curious property is mentioned by Helsham:—If a man placed in one scale, and counterpoised by a weight in the other, press the beam upwards, he will thus cause the scale in which he stands to preponderate.



FIRE ESCAPES.

FIRE ESCAPES.

(Resumed from page 155, and concluded.)

HAVING noticed the most celebrated fire escapes of a portable nature, we proceed to describe those of a larger kind; and first of carriage ladders. In the year 1809 Mr. John Davies submitted to the Society of Arts a fire escape, which consisted of three ladders connected to, and sliding upon each other, by means of ropes worked by a small windlass; a second windlass raised and lowered a cradle, supported by ropes passing over pulleys at the top of the uppermost ladder. This machine was mounted upon a low four-wheeled truck, drawn by a horse or by six men. Subsequently, Mr. Gregory greatly improved upon this escape; he employed three ladders sliding on each other, which, when lowered, were balanced horizontally upon a convenient frame mounted on a light four-wheeled carriage. When in this position they are capable of being run under low gateways, &c. with great facility. The ladders are brought into the perpendicular position, and then raised by a small windlass in the front of the machine, to any required height between ten feet and forty; the ladders are then inclined towards the window, upon the sill of which the top may be made to rest. To obtain a greater elevation than forty feet, one or more joints can be carried up and affixed. A cradle accompanies this machine, for the assistance of those who cannot descend the ladders. Mr. Gregory's ladder escape has been but partially employed for that purpose; as a valuable and convenient ladder, however, it has been very extensively used by architects and others.

Mr. John Hudson, the founder of a short-lived society for preventing loss of life by fire, in 1829, constructed an escape-ladder, differing in some respects from that of Mr. Gregory, although upon a similar principle. Fig 1 is a side view of Mr. Hudson's apparatus; A is the carriage mounted on four wheels, the front pair of which turn with their axis and handle B under the carriage, for the facility of guiding, stowage, &c.; FF are three ladders sliding in grooves one within another. The foot of the lowest ladder is hinged to a revolving centre in the middle of the floor of the carriage; D is an arched frame forming the quadrant of a circle, with ratchet-teeth on its edges, in which drops a pall or click G on a cross bar fixed to the back of the lowest ladder. The ladders usually lie in a horizontal position, as shown by the dotted line L; the palls and ratchet-teeth prevent the ladders from falling back while being elevated. In order to place them in the oblique position for use, they may be elevated by hand, or more easily by turning the windlass I round the barrel of which the rope K is wound, and the other end of it fastened to the ladders at about three feet above the floor. The ladders being thus brought to the position represented in the engraving, the motion of the windlass is continued, which winds off the rope from the ladders, and elevates them successively one above the other, until they gain the greatest height. The rope K passes through a pulley near the bottom of the lowest ladder, then over the top of it to the bottom of the next, and then over the top of the same to the bottom of the uppermost ladder. The pivot to which the ladders are hinged, is for enabling them to be veered round when it would be inconvenient to turn the carriage. The horizontal position is given to the ladders for enabling the machine to be conveyed through low passages, &c. There is a roller N at the top of the

ladder, to prevent friction when moving up against a wall, and a tackle fall at O for cradles, &c.

Mr. Joseph, who entertained a strong objection to the use of connected series of ladders, submitted the contrivance shown in Fig. 2, to public inspection:—A is a carriage capable of being drawn by two men, on which is fixed an elevated part B, sustaining a column of wood C; within this there is a smaller column of iron, capable of being raised by a rack and pinion, acted upon by the winch D; on the top of this internal column is an iron arm E on a swivel, having a cleft at its extremity to receive the long bar or lever F fastened to it by a bolt. The lower end of this bar is secured to the carriage by a pulley-tackle, which admits of an easy and secure adjustment at pleasure; to the upper end of this bar is suspended the cradle, &c. in the usual manner, with Guy ropes to guide the cradle in its descent; K is the handle for drawing the carriage. There is a small rope ladder at L, and a bolt and chain at the top of the column, for fixing the internal pillar (which has a range of eight feet) at the required elevation. The pillar has a joint near its base, by which it is turned down into the horizontal position whenever it is required to pass under gateways, &c.

In the year 1813, Mr. Thomas Roberts received a reward from the Society of Arts, for a "speedy elevator and fire-escape," of a very complex description, on the principle of the lazy-tongs; the same principle has since been employed under various modifications by numerous persons, and most recently by Mr. Doyle. The engraving, Fig. 3, represents Mr. Doyle's machine; AA exhibiting the combination of levers on one side of the machine; B is the frame that holds the lower pair of levers, and wherein the moving force is applied; C the carriage on four wheels, drawn by a handle not shown in the engraving; D is a stage or platform at the top of the machine, on which a fireman or other individual is raised to rescue the persons from the house on fire; at E there is a folding-bridge or gangway, to be projected into the window of a room; at F is a toothed pinion; G is a toothed quadrant, welded to the lowest lever-bar on one side, with its teeth taking into those on the upper side of the pinion; at K is another quadrant, the teeth of which take into the lower side of the pinion; motion being given to the pinion by the winch, the two quadrants are moved in opposite directions, and the series of levers are simultaneously operated upon in like manner, opening and shutting like so many pairs of shears, thereby drawing them all up closely together, or expanding to the extent of nearly their whole length. In the accompanying cut the machine is represented as only expanded to half the height it is capable of being extended. On the other side of the machine, there is, of course, a similar set of levers; they are connected to those already described by cross horizontal bars, the ends of which form the pivot joints on which the levers turn. The opposite side of the lower part of the machine is also a counterpart of that represented and the powers connected by a common axis to the opposite pinion. Although the principle of the movement is, perhaps, the best that could be devised for the purpose, the practical difficulties of executing such a machine on a large scale, have, we are informed, been found insurmountable, an attempt to construct one having failed.

Mr. Gregory, some few years since, patented a "portable derrick fire-escape," which consisted of

three square wooden pillars, sliding one within the other, mounted on a convenient carriage; the uppermost carried a pulley for raising a cradle, &c. The pulley was elevated by a windlass and rope connected with the pillars in the same manner as employed for raising his ladders.

Mr. Rose, of Manchester, constructed a fire-escape composed of an upright frame, fronted on a four-wheeled carriage; a second frame sliding within the former, carried at its top a small railed platform or gallery, in which people were received from the windows of houses; or it was occupied by a fireman with the branch of an engine, which enabled him more effectually to throw the stream of water upon the fire in lofty buildings. The sliding frame was raised by two chains attached to its lowest end, and carried over pulleys at the top of the first frame, to a windlass in the body of the machine; a ladder formed a communication between the body of the machine and the platform when it was in its lowest position.

Besides the escapes already noticed, there is yet another kind, which may be very properly designated "domestic fire-escapes," as they are intended solely for the use of the family in whose house they are placed. Some of the best of this class are those in form of a chair, sofa, or other convenient article of furniture, and stand in the recess of a window, outside of which they are soon placed, and constitute excellent fire-escapes, with every convenience necessary for a safe descent. Mr. Witty received a reward from the Society of Arts for an admirable escape of this kind. These machines, however, do not generally obtain patronage, for the mass of the people are too indifferent to this subject to provide themselves with escapes, but rather choose to trust to the chance of obtaining external aid. Various expedients have been resorted to, and different plans may be adopted to effect an escape from fire, according to circumstances. Egreys can sometimes be made at the top of a house, either by a door, or by an opening made in the roof with a poker for the purpose. Sheets and blankets tied together and fastened to the bed-post, or the bed-cords, attached in the same way, afford the means of descending; the feather-bed, &c. thrown out, serve to break the fall when jumping from the window as the last alternative. With a little contrivance, women and children may be lowered by means of the bed-clothes. Upon these occasions, all depends upon the persons in danger retaining so much presence of mind as will enable them to avail themselves of the best means in their power; and it often happens that pressing danger develops a great deal more ingenuity and intrepidity in individuals than they have previously taken credit for.

LAKE COLORS.

UNDER this title are comprised all those colors which consist of a vegetable dye, combined by precipitation with a white earthy basis, which is usually alumina. The general method of preparation is to add to the colored infusion a solution of common alum, or rather a solution of alum saturated with potash, especially when the infusion has been made with the aid of acids. At first only a slight precipitate falls, consisting of alumina and the coloring matter; but on adding potash, a copious precipitation ensues, of the alumina associated with the dye. When the dyes are not injured, but are rather brightened by alkalis, the above process is reversed;

a decoction of the dye-stuff is made with an alkaline liquor, and when it is filtered, a solution of alum is poured into it. The third method is practicable only with substances having a great affinity for sub-sulphate of alumina; it consists in agitating recently precipitated alumina with the decoction of the dye.

Yellow Lakes are made with a decoction of Persian or French berries, to which some potash or soda is added; into the mixture a solution of alum is to be poured as long as any precipitate falls. The precipitate must be filtered, washed, and formed into cakes, and dried. A lake may be made in the same way with quercitron, taking the precaution to purify the decoction of the dye-stuff with buttermilk or glue. After filtering the lake it may be brightened with a solution of tin. Annatto lake is formed by dissolving the dye-stuff in a weak alkaline lye, and adding alum water to the solution. Solution of tin gives this lake a lemon yellow cast; acids a reddish tint.

Red Lakes.—The finest of these is *carmine*. This beautiful pigment was accidentally discovered by a Franciscan monk at Pisa. He formed an extract of cochineal with salt of tartar, in order to employ it as a medicine, and obtained, on the addition of an acid to it, a fine red precipitate. Homburg published a process for preparing it, in 1656. Carmine is the coloring matter of cochineal, prepared by a precipitation from a decoction of the drug. Its composition varies according to the mode of making it. The ordinary carmine is prepared with alum, and consists of *carminium*, a little animal matter, alumina, and sulphuric acid.

Carminated Lake, called lake of Florence, Paris, or Vienna. For making this pigment, the liquor is usually employed which is decanted from the carmine process. Into this, newly precipitated alumina is put; the mixture is stirred, and heated a little, but not too much. Whenever the alumina has absorbed the color, the mixture is allowed to settle, and the liquor is drawn off. Sometimes alum is dissolved in the decoction of cochineal, and potash is then added, to throw down the alumina in combination with the coloring matter; but in this way an indifferent pigment is obtained. Occasionally, solution of tin is added, to brighten the dye. A lake may be obtained from *carmines*, in the same way as from cochineal; but now it is seldom had recourse to.

Brazil-wood Lakes.—Brazil wood is to be boiled in a proper quantity of water for 15 minutes; then, alum and solution of tin being added, the liquor is to be filtered, and a solution of potash poured in as long as it occasions a precipitate. This is separated by the filter, washed in pure water, mixed with a little gum water, and made into cakes. Or, the Brazil-wood may be boiled along with a little vinegar, the decoction filtered, alum and salt of tin added and then potash-lye poured in to precipitate the lake. For 1 pound of Brazil wood, 30 to 40 pounds of water, and from 1½ to 2 pounds of alum, may be taken, in producing a deep red lake; or the same proportions with half a pound of solution of tin. If the potash be added in excess, the tint will become violet. Cream of tartar occasions a brownish cast.

Madder Lake.—A fine lake may be obtained from madder, by washing it in cold water as long as it gives out color; then sprinkling some solution of tin over it, and setting it aside for some days. A gentle heat may also be applied. The red liquor must be then separated by the filter, and decomposed by the addition of carbonate of soda, when a fine red precipitate will be obtained. Or, the

reddish brown coloring matter of a decoction of madder may be first separated by acetate of lead, and then the rose-red color with alum. Or, madder tied up in a bag is boiled in water; to the decoction, alum is added, and then potash. The precipitate should be washed with boiling water, till it ceases to tinge it yellow; and it is then to be dried. The following process merits a preference. Diffuse 2 pounds of ground madder in 4 quarts of water, and after a maceration of 10 minutes, strain and squeeze the grounds in a press. Repeat this maceration, &c. twice upon the same portion of madder. It will now have a fine rose color. It must then be mixed with 5 or 6 pounds of water and half a pound of bruised alum, and heated upon a water bath for 3 or 4 hours, with the addition of water, as it evaporates; after which the whole must be thrown upon a filter cloth. The liquor which passes is to be filtered through paper, and then precipitated by carbonate of potash. If the potash be added in three successive doses, three different lakes will be obtained, of successively diminishing beauty. The precipitates must be washed till the water comes off colorless.

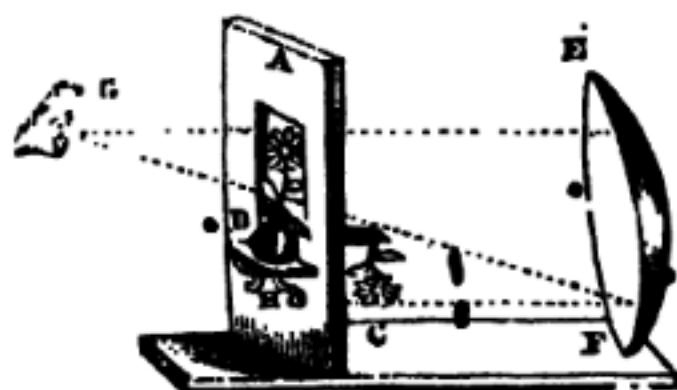
Blue Lakes are hardly ever prepared, as indigo, Prussian blue, cobalt blue, and ultramarine, answer every purpose of blue pigments.

Green Lakes are made by a mixture of yellow lakes with blue pigments; but chrome yellows mixed with blues produce almost all the requisite shades of green.

THE PHANTASMASCOPE.

(To the Editor.)

SIR.—On p. 8, vol. 4, of your valuable Magazine, it is requested to give a description of the phantasmoscope, I willingly avail myself of this opportunity to aid in furthering the science of optics.



Behind the partition *A B*, place in a position something oblique the concave mirror *E F*, which must be 10 inches at least in its diameter, and placed three-fourths of the distance of its centre. In the box or partition cut an opening 6 or 7 inches, which may either be circular or square, it must face the mirror, and be the same height with it; behind this partition place a strong light, so disposed as it may not be seen at the opening in front, and may illuminate the object at *C*, without throwing any light on the mirror. Beneath the aperture in box or partition, place the object at *C*, (that you intend shall appear on the outside of the opening) in an inverted position, and which we will suppose to be a flower, (as drawn) small busts, or any object sufficiently small for the size of the box, &c., or the aperture will take in; then place a small flower vase or pot on the shelf shown at *H*, the top of which should be even with the bottom of the opening, that the eye at *G* may see the object, which will appear as if the stalk came out of the vase. For busts, a small pedestal painted white. they will look

as if they were on the pedestal. Be particular to have all around the mirror and the inside of box painted a dull black, to prevent any reflection of light on the mirror; in a word, to dispose of the whole that it may be as dark as possible, and everything hid from the eye, as on this depends the force of the illusion. When a person looks in a direct line to the opening, he will see the object as if it stood from the box altogether, and on placing the vase, he will imagine it to grow out of it; but on putting the hand out to pluck it, he will find that he grasps at a shadow.

JOHN BROWN.

Newcastle on Tyne.

MAKING OF CYDER.

AFTER the apples are gathered from the trees, they are ground into what is called *pommage*, either by means of a common pressing stone, with a circular trough, or by a cyder mill, which is either driven by the hand or by horse power. When the pulp is thus reduced to a great degree of fineness, it is conveyed to the cyder press, where it is formed by pressure into a kind of cake, which is called the *cheese*. This is effected by placing clear sweet straw, or hair cloths, between the layers of *pommage*, till there is a pile of ten or twelve layers. This pile is then subjected to different degrees of pressure in succession, till all the *must* or *juice* is squeezed from the *pommage*. This juice, after being strained in a coarse hair-sieve, is then put either into open vats or close casks, and the pressed pulp is either thrown away, or made to yield a weak liquor, called *washings*. After the liquor has undergone the proper fermentation in these close vessels, which may be best effected in a temperature of from forty to sixty degrees of Fah. and which may be known by its appearing tolerably clear, and having a vinous sharpness upon the tongue; any farther fermentation must be stopped by racking off the pure part into open vessels, exposed for a day or two in a cool situation. After this, the liquor must again be put into casks, and kept in a cool place during winter. The proper time for racking may always be known by the brightness of the liquor, the discharge of the fixed air, and the appearance of a thick crust formed of fragments of the reduced pulp. The liquor should always be racked off anew, as often as a hissing noise is heard, or as it extinguishes a candle held to the bung-hole. When a favorable vinous fermentation has been obtained, nothing more is required than to fill up the vessels every two or three weeks, to supply the waste by fermentation. On the beginning of March, the liquor will be bright and pure, and fit for final racking, which should be done in fair weather. When the bottles are filled, they should be set by uncorked till morning, when the corks must be driven in tightly, secured by wire or twine and melted rosin, or any similar substance.

Devonshire Cyder.—Prefer the bitter-sweet apples, mixed with mild sour, in the proportion of one-third. Gather them when ripe, and lay them in heaps in the orchard. Then take them to the crushing engine, made of iron rollers at top, and of stone beneath; after passing through which, they are received into large tubs or sieves, and are then called *pommage*. They are afterwards laid on the vat in alternate layers of the *pommage* and clean straw, called *reeds*. They are then pressed, the juice running through a hair sieve. After the cyder is pressed out, it is put into hogshheads, where it remains for two or three days previously to fermenting. To stop the

fermentation, it is drawn off into a clean vessel; but if the fermentation be very strong, two or three cans of cyder are put into a clean vessel, and a match of brimstone burnt in it; it is then agitated, by which the fermentation of that quantity is completely stopped. The vessel is then nearly filled, the fermentation of the whole is checked, and the cyder becomes fine; but if, on the first operation, the fermentation is not checked, it is repeated till it is so, and continued from time to time, till the cyder is in a quiet state for drinking. Some persons, instead of deadening a small quantity with a match, as above directed, put from one to two pints of an article called *stun*, (bought of the wine coopers,) into each hogshead; but the system of racking as often as the fermentation appears is generally preferred by the cyder manufacturers of Devonshire. About six sacks, or twenty-four bushels of apples, are used for a hogshead of sixty-three gallons. During the process, if the weather is warm, it will be necessary to carry it on in the shade, in the open air, and by every means keep it as cool as possible. In nine months it will be in condition for bottling or drinking; if it continues thick, use some isinglass finings, and if at any time it ferments and threatens acidity, the cure is to rack it, and leave the head and sediment.

Scotch Method.—The apples are reduced to mullage, by beating them in a stone trough (one of those used at pumps for watering horses) with pieces of ashpoles, used in the manner that potatoes are mashed. The press consists of a strong box, three feet square and twenty inches deep, perforated on each side with small auger or gimblet holes. It is placed on a frame of wood, projecting three inches beyond the base of the box. A groove is cut in this projection one inch and a half wide, and one inch deep, to convey the juice when expressed out of the box into a receiving pail. This operation is performed in the following manner:—the box is filled alternately with strata of fresh straw and mashed fruit, in the proportion of one inch of straw to two inches of mullage; these are piled up a foot higher than the top of the box; and care is taken in packing the box itself, to keep the fruit and straw about one inch from the sides of the box, which allows the juice to escape freely. A considerable quantity of the liquor will run off without any pressure. This must be applied gradually at first, and increased regularly towards the conclusion. A box of the above dimensions will require about two tons weight to render the residuum completely free from juice. The residuum is excellent food for pigs, and peculiarly acceptable to them. The necessary pressure is obtained very easily, and in a powerful manner, by the compound lever pressing upon a lid or sink made of wood about two inches thick, and rendered sufficiently strong by two cross bars. It is made to fit the opening of the box exactly; and as the levers force the lid down, they are occasionally slacked or taken off, and the blocks of wood are placed on the top of the lid, to permit the lever to act, even after the lid has entered the box itself. Additional blocks are repeated until the whole juice is extracted. The pressure may be increased more or less, by adding or diminishing the weight suspended at the extremity of the lever. The liquor thus obtained is allowed to stand undisturbed twelve hours, in open vessels, to deposit sediment. The pure juice is then put into clean casks, and placed in a proper situation to ferment, the temperature being from 55° to 60°.

Champagne Cyder.—Good cyder (pale) 1 hhd.; spirit 3 gallons; honey or sugar 20 pounds. Mix and let them rest for a fortnight, then fine with skimmed milk $\frac{1}{4}$ gallon. This will be very pale, and a similar article, when bottled in champagne bottles, and silvered and labelled, has been often sold to the ignorant for champagne. It opens very brisk if managed properly.

Cheap-made Cyder.—Cyder (good) 1 hhd.; water 1 hhd., treacle 50 lbs.; alum (dissolved) $\frac{1}{4}$ lb. Match with brimstone.

General Rules for making Cyder.—1. Always choose perfectly ripe and sound fruit.

2. Pick the apples by hand. An active boy, with a bag slung over his shoulder, will soon clear a tree. Apples that have lain any time on the soil contract an earthy taste, which will always be found in the cyder.

3. After sweating, and before being ground, wipe them dry, and if any are found bruised or rotten, put them in a heap by themselves, for an inferior cyder to make vinegar.

4. Always use hair cloths, instead of straw, to place between the layers of pommage. The straw, when heated, gives a disagreeable taste to the cyder.

5. As the cyder runs from the press, let it pass through a hair sieve into a large open vessel that will hold as much juice as can be expressed in one day. In a day, or sometimes less, the froth will rise to the top, and in a short time grow very thick: when little white bubbles break through it, draw off the liquor by a spigot, placed about three inches from the bottom, so that the lees may be left quietly behind.

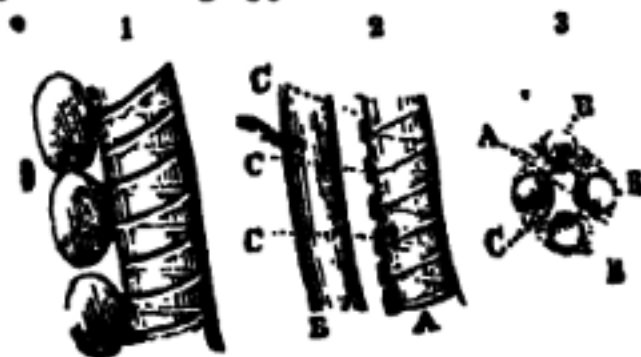
6. The cyder must be drawn off into very clean sweet casks, and closely watched. The moment the white bubbles before-mentioned are perceived rising at the bung-hole, rack it again. When the fermentation is completely at an end, fill up the cask with cyder, in all respects like that already contained in it, and bung it up tight.

ON THE TRANSFORMATION OF SPIRAL INTO DOTTED VESSELS IN FERNS.

To the Editor.

SIR,—Thinking the following original communication may be interesting to some of your readers, I send it for insertion.

I have lately satisfied myself that the youngest formed dotted tubes in ferns are really formed in the following manner:—Spiral vessels which are tolerably abundant in the young stems, are, as other spiral vessels, composed of a membrane and fibre, both distinct (*i. e.* not adherent;) and as the length of the stem increases in size, considerable lateral pressure must be exerted, in consequence of the stem not increasing in diameter, whereby the coils of the fibre are approximated, and the external membrane is firmly pressed against and becomes adherent to the lateral margin of each coil. I consider the following appearances as denoting this; in



the earliest stages of apparent dotted tubes the dots are of a deepish green color, whilst the rest of the tube is pale. This deepening of color in the dot is caused by the adhesion at these points of the fibre to the membrane; that the fibre really exists, may be readily demonstrated by careful dissection with needles. As the pressure increases, the adhesion of the membrane and fibre also increases; the portions where this pressure and adhesion takes place forms the dot, the portions of the tubes, corresponding to the intercellular and intervacular spaces, Fig. 1, C, remains as the undotted portions of the tubes. Hugo Mohl, in a late German publication, has proved that the arrangement and size of the dots in dotted vessels, varies according to the nature of the surrounding structures; he says, if they are surrounded by vessels or ducts, the dots will be arranged uniformly and regularly; if cellular tissue, then they will be irregular and lax in arrangement. This we should expect; inasmuch as where the pressure is caused by tubes, these (always having a considerable length compared with their thickness,) will cause the same adhesion all along their surface, but where the pressure is caused by cells, these generally being six-sided or rounded, the pressure cannot be so equal. The sketch shows this; in Fig. 1, the central tube is represented as surrounded by others, A being the tube about to be transformed; the black marks on its margin show where the lines of pressure against the spiral fibres will take place. Fig. 2 represents the same viewed laterally; A being the primary tube—the points of pressure marked C. Here we see how, inasmuch as the spiral fibre is regularly coiled, so the arrangement of the dots will be regular. Fig. 3 represents the pressure as formed by cells; here the cause of their irregularity must be obvious. This is, as I have before said, what Professor Mohl finds constant. G. W.

IMPROVEMENT OF STREET PAVING.

We earnestly direct the attention of our readers to a society lately formed, called the "Practical and Scientific Association for the promotion of Improved Street Paving," and of which prospectuses may be had at the offices of the society, 20, Vere Street, Oxford Street. The very name of such a society shows its importance to the whole community, and especially at the present time, when wood paving so deservedly occupies the public attention. The society already numbers among its members men of the first-rate talent, influence, and industry; and whose exertions, we can have no doubt, will effect a permanent and real benefit to society at large. The design of the association is to encourage a general adoption of wood pavement; and this they hope to accomplish by various plans, among which the following are the most conspicuous:—

To form a museum of all the improved systems for making carriage ways.

To collect and disseminate the most correct information respecting them.

To invite the co-operation of men, eminent for their practical and scientific experience on this subject.

To adopt such measures as will ensure justice and impartiality to inventors and patentees.

To pursue such a course as will lead to the introduction of that pavement, which for its general utility and economy, shall not fail to obtain the approbation of the public at large.

The following abstract of the last meeting of the society is well worth attention:—

"The committee granted the use of their rooms in Vere Street, on Wednesday, the 10th of August, to Mr. Rodway, the patentee of the concave horse shoe, on which occasion, there was a numerous attendance of the committee and their friends; of veterinary surgeons, omnibus proprietors, and scientific gentlemen, to procure a more extensive inquiry into the merits of the concave shoe, than it had heretofore been subjected to.

"The patentee, having been called upon by Captain Ibbetson, the chairman, proceeded at considerable length to explain the defects of the common shoe, and of the present mode of shoeing; and the advantages suggested in the use of the patent concave shoe. The illustrations were made by the exhibition of a piece of the patent rolled iron, as supplied for the purpose of making the shoe; a shoe in its simple form, and fixed to a horse's hoof. The peculiar adaptation of this shoe to wood pavements was exemplified by its application on the various specimens of wood paving, collected in the museum of the association, and completely established the fact, that the concavity in the formation of the patent shoe enables the horse to take a perfect hold on wood pavement. Mr. Rodway succeeded, also, in demonstrating to the meeting, by a variety of interesting remarks on the construction of roads, in reference to the draught and power of horses, that this simple, though highly-important improvement in shoeing them, must prove a powerful aid in the progress of wood paving, by disposing of the only remaining objection to the universal application of wood for the making of carriage-ways.

"The patentee, in the course of his observations, dilated at some length on the violation of natural principles in the system of shoeing horses, as now generally practised, and drew some comparisons to show how far horses had succeeded in adopting this necessary auxiliary of art to the natural functions, for the protection of the horse's foot, in trafficking over made roads; from which it was gleaned, that the formation of the outer and inner rims of the concave shoe is adopted with a view to increase, (which it is stated it does in a manifold degree) the hold or purchase of the horse upon the ground, by which also the animal is able to use his limbs with increased confidence and safety. The concave shoe is not liable to be thrown; it is lighter, it will not require removing, and it will obviate, in a great degree, the objectionable necessity of turning up in winter. These facts are thus made to appear,—first, the shoe is prevented from being thrown, by the nails being driven and counter-sunk in the concavity, which effectually prevents them from wear, and causes them to last as long as the shoe; secondly, by taking away the iron that would fill the concavity, it is of course lighter to that extent; thirdly, as the nails cannot become loose, removing will not be necessary; fourthly, the open heels of the shoe being pressed upon by the weight of the horse, naturally sink into, or penetrate the substance trodden upon, and by acting as hooks or wedges, enables the horse to tread with firmness and security upon wooden pavements; avoiding in effect, the use of spikes or stilt, for calkings, according to the practice of turning up. From these results, Mr. Rodway anticipates a very great improvement in the power and in the general health of horses.

"Mr. Rodway having concluded his general exposition, the chairman requested the favor of gentlemen to proceed in the inquiry, by expressing their opinions, or questioning the patentee.

Mr. Dickson, veterinary surgeon, stated that he had shod his horses on the 20th of July, with the patent concave shoe, had worked them constantly since, frequently over wood pavement, and always without slipping; having been on three weeks, the shoes were not more than half worn. Mr. Dickson said he had not the slightest doubt of the concave shoe being brought into general use, as preferable in every respect to the common shoe. Mr. Woodin had shod his horses with the patent concave shoe; he stated that the shoe wears well, is peculiarly well adapted for wood pavement, is preferable in every respect as a general shoe; in cases of diseased hoofs or feet, it will require some pains in fitting, as with the common shoe; that he considered its use desirable for the consumer,—its application profitable to the smith,—and that in respect of draught horses, he, Mr. Woodin, having to shoe a certain number of brewer's horses by contract, had, with the permission of the owner, supplied the patent concave shoe with advantage to his employer, and he need scarcely add, with benefit to himself. The patentee was minutely questioned by several scientific gentlemen present, particularly in respect of the comparative amount of friction of the common and the patent shoe; and from his replies we gathered, that the general use of the concave shoe is likely, very considerably, to decrease the amount of wear and tear of roads; but it is obvious, that no data can exist to base any calculations of this nature upon, until obtained by experience, which time alone may produce.

"We learnt with pleasure, that the concave shoe is to be tested on the principal line of omnibuses, and that the patentee is daily making progress in granting licenses, of which a great number of the principal farriers have already availed themselves.

"These interesting proceedings, which included an animated discourse on the physiology of the horse, are to be published in the form of a pamphlet; in the mean time, whether Mr. Rodway may eventually succeed in procuring the general adoption of his shoe, or whether Mr. Rodway's shoe is only a precursor to still greater improvement in that essentially-important article, it is most satisfactory to the friends of wood paving to perceive, that, one by one, all the objections to wood paving are demolished." The shoe itself may be seen at the offices of the society.

TO PRESERVE SEEDS AND ROOTS.

THE best means of effecting this are those which have been followed by that distinguished botanist, M. Soulangue Boudin, who has had long experience in this business.

All seeds, intended for transportation, should be collected in a state of perfect maturity. The finer seeds may be inclosed in good paper bags, but those which are larger must be placed in layers, in very dry sand, and the whole packed in air-tight vessels. The stratification in dry sand is a precaution which alone would preserve their germinating property for many years, and during the longest voyages. Saw-dust is also a good article, but it is necessary to take the precaution of placing it in an oven, as we do bran, when we wish to purify it from mites, or from eggs of other insects. Oleaginous seeds, which are liable soon to become rancid, such as those of the coffee plant, the oak, nut trees, the tea tree, &c. require, when stratified, to be kept with great care separate from each other, in sand which is very

fine, and very dry. Those which are of a middle size may be sent in their pericarps, inclosed air-tight in small cups or pots, by covers of glass, fixed on with putty; or of wood or cork, imbedded in melted wax, or, which is better, in melted pitch. Juicy seeds must be separated from each other, as contact would, sooner or later, inevitably cause a fermentation which would destroy them. Roxburg dips them into a solution of gum arabic; this, as it hardens, forms a coat, which defends them against every principle of destruction, and enables him to transmit them from the Coromandel coast to Europe, without undergoing the slightest change. With respect to bulbous roots, and other plants with roots, which always require a length of from two to three feet in their shoots or slips, it is best to place them either in earth, taken from the spot where the plant vegetates freely, or in some other earth well divided and mixed, and rather too dry than too moist; the mould formed of the rotten trunks of trees is very good for the purpose; but it is necessary to ascertain that it does not contain insects. Vegetables treated in this way have been brought by M. Perrottet from the South Sea, and have all lived. The whole may be inclosed in little wooden casks well hooped, and covered, inside and out, with a bituminous coating. So situated, seeds are unalterable; and when the vessels are well closed, neither insects, external air, or moisture, will injure them.

Seeds should only be gathered when quite ripe, and dried by exposure to the air or sun, without heat, on paper trays. Seeds, generally speaking, keep better in the shells or pods than out of them.

Inclose them in bottles in well dried brown sugar. Bees' wax is also used.

WHITE INDIGO AND CARBAZOTIC ACID.

THE extraordinary change which indigo, or rather its coloring principle, undergoes by the action of deoxidising agents, has been studied by Liebig. He obtained white or deoxidized indigo (*indigogene*) as follows:— $1\frac{1}{2}$ part of pure indigo, 2 parts of proto-sulphate of iron, $2\frac{1}{2}$ parts of hydrate of lime, and from 50 to 60 parts of water, were digested together for 24 hours in a close vessel which had previously been filled with hydrogen. The clear liquor over the sulphate of lime and oxide of iron had a yellowish red color, and was separated by a siphon filled with hydrogen, and mixed with diluted muriatic acid, containing some sulphite of ammonia dissolved; a dense white precipitate was formed, becoming blue in the air. This was gathered in a filter out of contact of air, and washed with boiled water containing sulphite of ammonia in solution, and dried at 212° in close vessels, through which a current of hydrogen was continually passed. The upper surface of the mass became of a blue color, but the lower remained of a dull white. This white substance was called *indigogene*. It did not change color in dry air, but under water became of a deep-blue, which, by drying, assumed a coppery appearance. The blue substance volatilized by heat, without leaving any residue, forming purple vapors, which condensed, when cold, into crystals differing in nothing from sublimed indigo. *Indigogene* dissolves in alkalis without neutralizing them; it is also soluble in water or acids.

A given quantity of this *indigogene* was acted upon by ammonia and the weight of the undissolved

ble portion ascertained; it appeared that the weight of the pure portion dissolved was 0.404 grammes (6.224 grains). The solution was put into an inverted jar, over mercury, and oxygen gas gradually passed in until absorption ceased, and then the liquid containing the precipitated indigo was evaporated to dryness at 212° . The weight of the substance was increased to 0.047, i. e. 11.5 per cent.

The action of nitric acid on indigo has subsequently been studied by Liebig, who finds a peculiar acid among the results afforded by treating indigo with excess of nitric acid, which he terms *carbazotic acid*, and respecting the production and properties of which he has given the following details:—

A portion of the best indigo is to be broken into small fragments, and moderately heated with eight or ten times its weight of nitric acid, of moderate strength. It will dissolve, evolving an abundance of nitrous vapors, and swelling up in the vessel. After the scum has fallen, the liquid is to be boiled, and nitric acid added, whilst any disengagement of red vapors is occasioned by it. When the liquid has become cold, a large quantity of semi-transparent yellow crystals will be formed, and if the operation has been well conducted, no artificial tannin or resin will be obtained. The crystals are to be washed with cold water, and then boiled in water sufficient to dissolve them. If any oily drops of tannin form on the surface of the solution, they must be carefully removed by touching them with filtering-paper. Then filtering the fluid, and allowing it to cool, yellow brilliant crystalline plates will be obtained, which will not lose their lustre by washing. To obtain the substance perfectly pure, the crystals must be re-dissolved in boiling water, and neutralized by carbonate of potassa. Upon cooling, a salt of potassa will crystallize, which should be purified by repeated crystallizations. On mixing the first mother-liquor with water, a considerable brown precipitate will be obtained, which being dissolved in boiling water, and neutralized by carbonate of potassa, will also furnish a quantity of the salt. All the potassa-salt obtained in these operations is to be re-dissolved in boiling water, and nitric, muriatic, or sulphuric acid added; as the solution cools, the peculiar substance will be observed to form very brilliant plates of a clear yellow color, generally in equilateral triangular forms. Sometimes crystals are not formed after the action of the nitric acid on the indigo, in which case, the liquor must be evaporated, and water added, when the substance will precipitate, and must be purified as already described. Four parts of indigo yield one of the pure substance.

When the substance is heated, it fuses, and is volatilized without decomposition; when subjected to a sudden strong heat, it inflames without explosion, its vapors burning with a yellow flame, and a carbonaceous residue remaining. It is but little soluble in cold water, but much more in boiling water; the solution has a bright-yellow color, reddens litmus, has an extremely bitter taste, and acts like a strong acid on metallic oxides, dissolving them, and forming peculiar crystallizable salts. Ether and alcohol dissolve the substance readily. When fused in chlorine or with iodine, it is not decomposed, nor does solution of chlorine affect it. Cold sulphuric acid has no action on it; when hot it dissolves it, but water separates the substance without alteration. Boiling muriatic acid does not affect it,

and nitro-muriatic acid only with great difficulty. These results show that no nitric acid is present in the substance, and other experiments prove that no oxide of nitrogen exists in it; it contains no oxalic or other organic acid, for when its salt is boiled with chloride of gold, the latter is not reduced. When heated to redness with oxide of copper, it gave a mixture of nitrogen and carbonic acid, in the exact proportion of one volume of the former to five of the latter. This was a constant result, and in no case was any sulphuric or other acid left in the copper. This compound, therefore, called *carbazotic acid*, is represented by Liebig as destitute of hydrogen, and as consisting of

Nitrogen	3 atoms.
Carbon	15 "
Oxygen	15 "

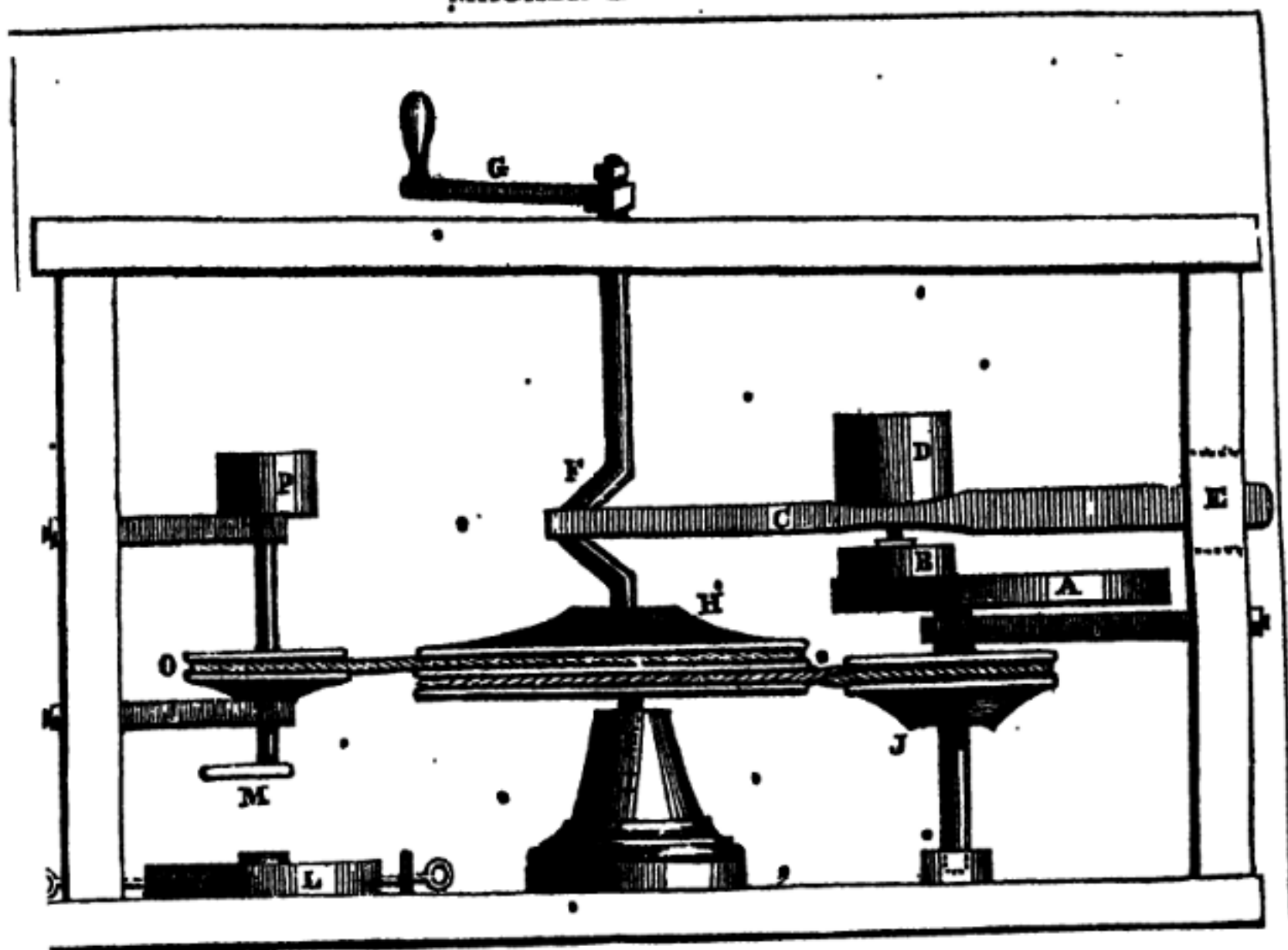
TO FIND THE MAGNIFYING POWER OF TELESCOPES.

Put up a small circle of paper, an inch or two in diameter, at the distance of about a hundred yards; draw upon a card two black parallel lines, whose distance from each other is equal to the diameter of the paper circle. Then view through the telescope the paper circle with one eye, and the parallel lines with the other, and let the parallel lines be moved nearer to or farther from the eye till they seem exactly to cover the small circle viewed through the telescope. The quotient obtained by dividing the distance of the paper circle by the distance of the parallel lines from the eye will be the magnifying power of the telescope. A little practice is necessary before this experiment can be made with accuracy.

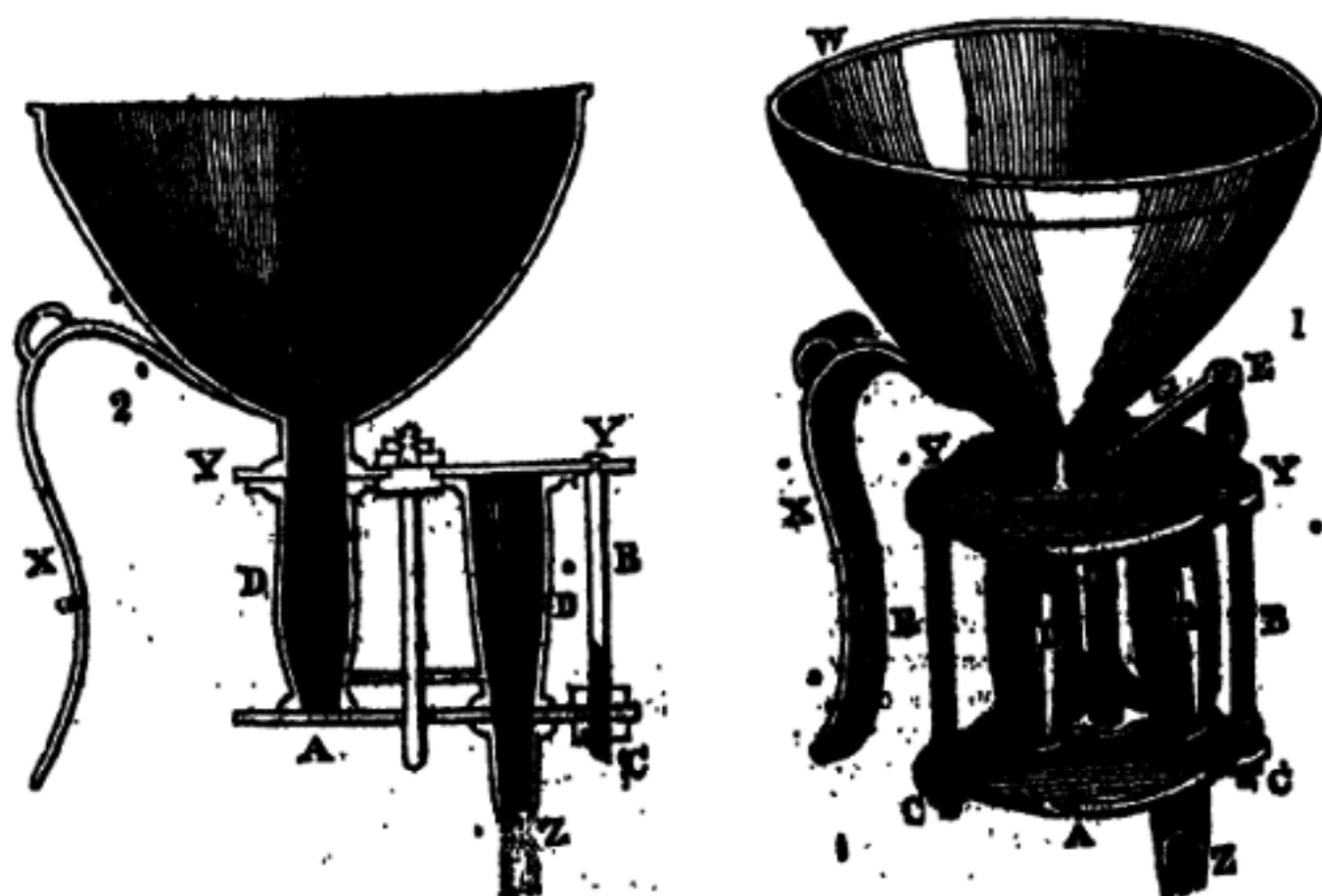
REVIEW.

Gas Meters; their unfairness considered, and the loss arising to the Consumers of Gas by their use pointed out, with Instructions for proving their deficiency of Measure; and Directions for keeping a Meter in order.—Mann, Cornhill.

THE above is the title page of a pamphlet of some importance, though little pretension. The author justly says, that the gas meter is but little understood by the general consumer, who, for want of this knowledge, is daily losing the enormous average of from 10 to 30 per cent. upon all the gas which he consumes, or rather which he pays for. He states that the examination of a great number of meters has proved, that, without a single exception, they are incapable of affording just measure; in fact, that there is scarcely a meter that *bona fide* gives 900 feet for the 1,000 registered, and in many instances not more than 600 or 700 feet. The author explains the full construction of the meter, and gives clear information as to its proper management; his pamphlet is therefore of the utmost utility to the community, and we sincerely trust will have the effect of putting the public more on their guard against the companies who supply the gas, and who it is but too apparent, even supposing their meters to be originally correct, yet allow the consumer to defraud himself by improper management of the instrument which they have supplied, and which their honest caution would, in a great degree, have prevented. We strongly recommend the pamphlet to all.



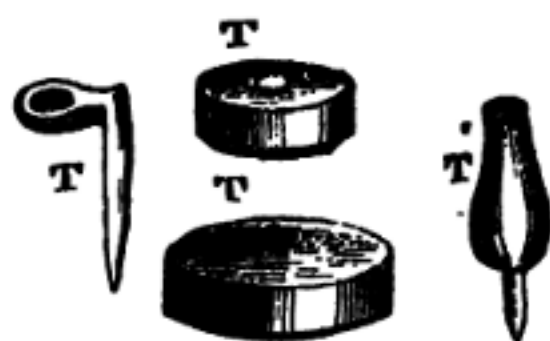
MACHINE FOR GRINDING LENSES.



MACHINE FOR FILLING CARTRIDGES.

GRINDING LENSES.

A VARIETY of simple apparatus is employed in the processes of grinding and polishing lenses, amongst which is the following :—A shows the edge of a circular lap or slab, used for grinding flat glasses upon. B a circular tool or block, upon the under surface of which the glasses to be ground are cemented. C is a reciprocating bar. D a box containing any weighty matter. E a long shorticed aperture in the frame, through which the bar C freely works. F a crank. G a winch. H a double pulley wheel, the axis of which rests in the block I. J a single pulley wheel. Now on turning the crank by the winch G, the bar C gives to B an eccentric motion; the attrition of B on the surface of the lap A being increased or diminished at pleasure by increasing or diminishing the load in the box D. It should be noticed, that the cord which passes round the pulley H is crossed previous to its embracing the periphery of the pulley I, consequently a motion is given to the lap A the reverse of that given to B, which is considered to produce the best effect of grinding. The apparatus described is devoted to the producing of plane surfaces to optical glasses; but the apparatus on the other side of the machine, is, at the same time, by similar arrangements, employed in grinding concave or convex surfaces. For this purpose a variety of laps and other tools, similar to those delineated below, are so made as to fit on



the bed L, which bed is adjustable by four equidistant screws. The pulley O is driven by another band on the pulley H, and the required pressure given by another loaded box P; the use of the lower tool M is intended to fix a diamond at the point, for cutting the glasses out of a true circular figure, by being screwed on at M. The several tools used are adapted for ready changing, that the operations may be performed with celerity.

MACHINE FOR FILLING CARTRIDGES.

THE second engraving of the present No. represents an ingenious and well-contrived machine, invented by W. Caffin, Esq., of Woolwich, for filling cartridges, but which, if constructed on a larger scale, may be applied to measure grain, seed, and all other articles that are estimated by strike measure. Fig. 1 represents a perspective view of the instrument, and Fig. 2 an elevation in section. The measures D D are fixed vertically in a circular plate F opposite to each other, with an axis between them, upon which they work between two other plates. On the top plate Y Y a hopper W is fixed, communicating alternately with the measures, and filling them; and on the opposite side, in the bottom plate A, is a hole with a spout Z, through which the discharge takes place. The plates are framed together by three pillars B B b, having double adjusting nuts C C on each to regulate the distance of the plates.

The measures are moved by a handle or lever E, the motion of which is limited by two pins G G, which, while it presents one under the hopper to receive, places the other immediately over the discharge hole for delivery, so that the two operations of filling and discharging are going on at the same time. The bottom of each measure is contracted, to retard, in a small degree, the discharge, so as to secure one measure being filled before the other is emptied. A hole is cut in the top plate over the discharging measure, by which it may be ascertained that it is always perfectly filled, as well as that the whole of its contents are delivered; X is the hook by which the machine is supported. Some of these machines have been used a long time for filling cartridges, and a boy delivers with ease 12,500 measures daily, from one machine, in the most perfect and accurate manner, and supplies his hopper himself.

THE SEAL FISHERY.

No products of the amphibia are, upon the whole, more valuable than the oil and skin of the seal. The oil obtained both from the walrus and seals is of a quality superior to that of the common whale, and brings a higher price. "It yields oil," says Scoresby, speaking of the sea-horse, "which, when extracted before putrefaction has commenced, is beautifully transparent in its appearance, free from smell, and not unpleasant to the taste." Soon after Captain Cook's voyage, in the *Resolution*, in 1771, he presented an official report concerning New Georgia, in which he gave an account of the great number of proboscis seals and fur seals which he had found on the shores of that island. This induced several enterprising merchants to fit out vessels to take them; the former for their oil, the latter for their skins. Captain Weddell states that he had been credibly informed, that during a period of about fifty years not less than 20,000 tons of oil were procured annually from this spot alone for the London market; a quantity which, at a moderate price, would yield about £1,000,000 a year.

The skins are very much used in their raw state as articles of apparel by the natives of the polar zones. When tanned, they use them extensively in making shoes; and the Esquimaux have a process by which they render them waterproof; so that, according to Scoresby, the jackets and trousers made of them by these people are in great request among the whale-fishers, for preserving them from oil and wet. But the skins are not only used in this raw and tanned state as leather; on account of their silky and downy covering they constitute still more important articles connected with the fur trade. Thus considered, seals' skins are evidently of two kinds, which may be distinguished as hair-skins and fur-skins. The former are used for clothing and ornament by the Russians, Chinese, and other nations, and the latter yield a beautiful fur. Many seals supply nothing but hair, whilst others, in different proportions, produce both the hair, and underneath it a soft and downy fur. The majority are to be considered merely as hair-skins, similar to the bear or sable; and of these some are excellent of their kind, and are much prized.

But the finest of the hair-seal skins yield in value and importance to the other variety, the fur-seal skin. This fact is thus alluded to in the last edition of the *Encyclopædia Britannica*:—"From about

the year 1806 till 1823 an extensive trade was carried on in the South Seas in procuring seal skins, which in that part of the world are covered with a fine fur. These were obtained in vast abundance by the first traders, and yielded a very large profit." The remark we have just made that hair and fur are frequently both present is as applicable to the fur-seals, as to the others. But the question here occurs which are the fur-seals? And that intelligent mariner we have before quoted, and who was so largely engaged in this trade, declares that naturalists know nothing about it. Mr. Weddell invariably speaks of the fur-seal as one species, (the *Falklandica*), distinct from all others. He remarks,— "The circumstance of its possessing a valuable fur has not been noticed in any description of the seal with which I have met." The time was when cargoes of those skins yielded five or six dollars a piece in China; and the present price in the English market averages from 30s. to 50s. per skin. The number of skins brought off from Georgia cannot be estimated at fewer than 1,200,000; the Island of Desolation has been equally productive; and in addition to the vast sums of money which these creatures have yielded, it is calculated that several thousand tons of shipping have annually been employed in the traffic.

It is a curious fact, that whilst the Americans were for many years most successfully prosecuting this trade, England was not profiting by it, and though quantities of the fur-seal skin were brought home, "the furriers in England had not the method of dressing them; on which account they were of so little value as to be almost neglected." Now, the inquiry here suggests itself,—If there was a time when our artificers could not, and did not, dress this skin when put into their hands, and when naturalists knew little or nothing specifically about the true fur-seal, may it not happen that there are other seals whose fur is really as valuable, and which might now be turned to a similar profit? The Americans regard many seals as fur-seals, which are unknown to naturalists, and quite distinct. Thus, according to them, the fur-seal of Patagonia has a bump behind its head; that of California is of very large dimensions; the upland seal, or that which retreats far from shore, is small, and exclusively inhabits the Macquarrie Islands and Pennantipodes; and, finally, that of the South of New Zealand has other and distinct characters. The truth then may be, that many seals produce, in high perfection, that article which is now so much desired, and which would yield so rich a return.

It may be considered superfluous to read a lecture to the trader upon a matter so nearly touching his own interest; and yet, at the same time there is one point which forms so essential a part of our subject, that we cannot withhold a word or two. These valuable creatures have often been found frequenting some sterile islands in innumerable multitudes. By way of illustration, we shall refer only to the fur-seal, as occurring in South Shetland. On this barren spot their numbers were such that it has been estimated that it could have continued permanently to furnish a return of 100,000 furs a year; which, to say nothing of the public benefit, would have yielded annually, from this spot alone, a very handsome sum to the adventurers. But what do these men do? In two short years, 1821-2, so great was the rush, that they destroyed 320,000. No wonder, that at the end of the second year the animals in this locality were nearly extinct. So is it, we add, in

other localities, and so with other seals; so with the oil-seals, and so with the whale itself, every addition only making bad worse. And all this might easily be prevented by a little less barbarous and revolting cruelty, and a little more *enlightened* selfishness. Fishermen are by law restrained as to the size of the meshes of their net in taking many of our more valuable fish; and in the Island of Lobos, in the River Plata, where there are quantities of seals, their extermination is prevented by the Governor of Monte Video, who farms out the trade under the restriction that the hunters shall not take them but at stated periods, ages, &c. We could enlarge on this point, but our exhausted space forbids.

The *seal-fishing* in the Northern hemisphere has never been prosecuted with any energy by the British. The ships which are fitted out for the whale-fishery occasionally obtain from 2000 to 3000 seals, and sometimes more, and vessels sent out for the seal-fishery alone, and which seldom amount to more than one or two annually, have occasionally procured a cargo of 4000 or 5000, yielding nearly 100 tons of oil. From the Northern parts of Europe, however, and more especially from the Elbe and Weser, there are frequently upwards of fifty sail despatched. In a good sealing year the number captured off the coasts of Newfoundland has amounted to many hundreds of thousands. The trade is one of much hazard, and leads to perils and adventures not less disastrous and exciting than the whale-fishery itself.

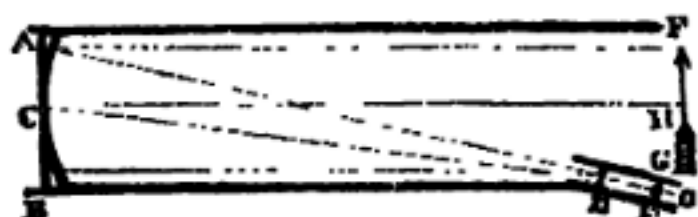
With regard to the seal-fishery of the South, the English and Americans have exclusively divided it between them, and with very great profits. It has lately been stated that they together employ not fewer than sixty vessels in the trade, of from 250 to 300 tons burden. These vessels are strongly built, and have each six boats, like those of the whalers, together with a small vessel of forty tons, which is put in requisition when they reach the scene of their operations. The crew consists of about twenty-four hands; their object frequently being to select a certain fixed locality, from which they make their various *ballies*. Thus it is very common for the ship to be moored in some secure bay, and to be partially unrigged, whilst, at the same time, the furnaces, &c. required for making the oil, are placed on shore. The little cutter is then rigged and manned with about half the crew, who sail about the neighbouring islands, and send a few hands on shore when they see seals, or where they wish to watch for them. This vessel can hold about 200 seals, rudely cut up, which will yield about 100 barrels of oil; this is transported to head-quarters and melted. The campaign frequently lasts for three years, and in the midst of unheard-of privations and dangers. Some of the crew are sometimes left on distant barren spots, and the others being driven off by storms, they are left to perish, or drag out for years a most precarious and wretched existence.

ON THE HERSCHELIAN REFLECTING TELESCOPE.

(To the Editor.)

THE Herschelian reflecting telescope has been little noticed by any writers of scientific works, and even those who have noticed it have apparently not understood the nature of the instrument which they have attempted to describe. They have all stated

that the Herschel plan is only applicable to large instruments, and for this reason not of such general utility as either the Newtonian or Gregorian reflectors. Now in opposition to this opinion I can state, that I have been in the habit of making and using this kind of telescope for the last twenty-five years; and from my own observations I can say that they are, when properly constructed, nearly as much superior to either the Newtonian or Gregorian, of the same aperture as achromatics, and are capable of being made of any size to suit the fancy or necessities of the operator. The following figure will show the construction of this kind of telescope:—



A B is the concave reflector, whose focus is at D, where the inverted image of the object F H G is formed. This image is viewed by the eye-glass E, which may be either a single or compound eye piece. The chief point to be attended to in the construction of this telescope is to make the focus such, that the angle H C D shall not be more than $3^{\circ} 30'$, as I have never been able to get them to act well when this angle was larger. My general rule is to make the focus of the large mirror 16 diameters, and to place the centre of the eye piece (C) at $1\frac{1}{2}$ inches from the extreme edge of the object aperture. This distance will just allow for the head without obstructing any of the light incident on the large reflector. I have made this kind of telescope of 3, 4, 5, and 9 inches aperture, with perfect success. My favorite working instrument is 5 inches aperture and 80 inches focus, and has power from 45 up to 700 times. With this instrument I can see in the most beautiful manner the division in the ring of Saturn, and can separate many of the most difficult of the double stars. It will likewise most easily resolve that beautiful nebula in Hercules. I would, however, observe that to get a telescope to show those difficult objects well requires a degree of accuracy in the figuring of the metal which is only to be obtained by long practice; for the Herschel reflector, on account of its much larger quantity of light, requires a degree of accuracy in the figure far superior to what is required in any other form. My method of obtaining such an accurate figure I shall be most happy to communicate in some future number of the Magazine.

From a variety of experiments, made with the greatest care, and often repeated, I find that telescopes of various constructions, each made of the very best materials, and charged with equal powers, require to be of the following apertures, so that each shall represent objects equally bright.

Achromatic, $2\frac{3}{4}$ inches; Herschel, 3 inches; Newtonian, $3\frac{1}{2}$ inches; Gregorian, $4\frac{1}{2}$ inches; or the diameter of the apertures require to be in the proportions of 11, 12, 15, and 17; the four being in the proportions of 16, 16, 12, and $4\frac{1}{2}$. Now I would observe, that to any person who has given the matter serious consideration, it must appear very evident why the Gregorian requires to be of such a large aperture, for from its being so extremely short, a very large quantity of light is lost by aberration: so great indeed is this in telescopes that the quantity of light is increased by length of

focus, nearly in proportion to the cube root of such length, or in other words, a mirror of eight times the focal length of a given one has nearly double the light; the apertures being equal. The same observations will equally hold with respect to achromatics, and may be proved from the fact, that 1 circular inch, taken in the centre of an object glass or metal, will afford more illuminating power than 4 circular inches taken in the form of a ring round the periphery.

I may conclude by stating, that the Herschel telescope, as above described, is so very simple in its construction, possesses so high an illuminating power, and is so very convenient for use at any altitude, that it is well worthy of the attention of the practical astronomer.

J. D. SOILLITT.

Hull Grammar School,
Sept. 5th, 1842.

HISTORICAL PAINTING.

(Resumed from page 168.)

In his celebrated treatise on painting, Leonardo da Vinci says, "Avoid hard outlines; the boundaries which separate one body from another are of the nature of mathematical lines, but not of real lines. The end or edge of any color is only the beginning of another, and ought not to be called a line, for nothing interposes between them. Let the colors of which the draperies of figures are composed be such as to form a pleasing variety, to distinguish one from the other. Figures acquire a beautiful relief by a proper gradation and strength of shadows. The masses which surround the figures will help the more to detach them, the more they differ from the objects. Whoever flatters himself, that he can retain all the effects of nature in his memory is deceived: our memory is not so capacious, therefore consult nature for every thing."

When a desire has been excited to portray any event in which the higher studies are requisite, the student must look to anatomy as being of indispensable importance. Those who are unacquainted with the particular form of the bones, and in what manner the muscles which move them are attached and act, will necessarily fall into errors in drawing, in the representation of actions. Out of four hundred muscles in the human body, there are not one hundred which are obvious or exterior, the chief that an artist requires to study. The knowledge of these besides is by no means so difficult to acquire as it may at first sight appear: perseverance will do wonders. Plaster casts may answer us well or better than living models, for obtaining a knowledge of the muscles in a state of rest; but there are movements produced by sudden impulses, which, by changing the form of the muscles, materially affect the outline, and these cannot be studied in casts or in prints. Living models are excellent for attitudes of exertion, inasmuch as every action demands its particular colour, affected by the different degrees of energy or passion; and such positions may be assumed according to directions given. Impulses, however, cannot be in this way made obedient, and consequently there are excellences, which must be snatched as it were from nature by fortunate observation of accidents, and imparted to pictures from memory. In the highest departments, this can only apply to nudity; but so far as expression and general attitude are concerned in clothed figures, the student may depend on common observation,—Nature always accords with the mechanical princi-

ples of anatomy and the geometrical laws of perspective, the imitation of which leads to perfection. Such is the system that has been pursued by artists, who have obtained the applause of the judicious.

No one can represent a subject which he has never seen, even from the most minute description. It is reported that a German artist, who had never seen a lion, attempted to paint Daniel in the lion's den, and succeeded well in representing the cavern with all its irregularities of surface and terrific effect. The human figure, with an expression of reliance on divine protection, was also truly depicted, for the artist had carefully studied all these in nature. But when he came to the lions, he must have felt all the anxieties of one travelling in the dark; and he ended by representing something half-bear, half-wolf, conformable to the imaginary idea which he had conceived. In consequence of his thus having overstepped the bounds of his knowledge, no one recognised his imaginary animals for lions; and the picture being universally censured was laid aside till he had seen how the error might be corrected.

Just criticism is friendly to art, and is so appreciated by artists of talent; for where there is no perception of error, there can be little prospect of improvement. The student will do well therefore to listen to every just remark, and seize on every circumstance from which a useful hint may be obtained, taking care to remember, that it is a greater triumph to captivate the understanding, than to charm the senses—to please the eye of taste, than to attract the gaze of the vulgar.

Incongruities and inaccuracies as to time, or anachronisms, have been committed by many artists, and remain sad evidences of ignorance and want of consideration. Paul Veronese, in a magnificent scene of the marriage of Cana, has represented Benedictine monks in modern costume. Tintoret, in his picture of the Hebrews gathering manna, has armed some of them with firelocks! Chella delle Paera, in the picture of the Annunciation, in a church at Capua, has rested the Virgin in a carved arm-chair of crimson velvet with gold flowers, and on a table he has placed a silver coffee cup and pot: a cat and a parrot are also introduced. Breughel, in a picture of the Eastern Magi, has given an Indian king a white surplice, with boots and spurs; and he bears in his hand, as an offering to the child, a model of a Dutch twenty-four gun-ship. A living artist of note, Haydon, in his picture of Jesus entering Jerusalem, has introduced modern portraits, such as those of Voltaire and Wilberforce. There are numerous similar errors associated with names of even greater eminence, at which common sense revolts; but however true it may be that nothing is more easy than to find fault, it is equally true that nothing can excuse the painting of absurdities. Historical representations should be as true to the circumstances as the expression should be true to nature; for falsehood is a deformity as offensive, as beauty and truth are attractive.

Light and shade may bear some reference to the locality of a scene; but they are generally adapted to the most advantageous display of the outline. The same may be said of colors.

To Rubens the whole range of nature seemed equally familiar, from the lower pastimes of the Flemish peasantry to the elegant ideas embodied in his allegory of Mary de Medicis, or the more lofty combinations of grandeur displayed in his Descent from the Cross. The free, the florid, and the superb styles of which he was master, are often how-

ever deteriorated by the introduction of inelegant forms, particularly those of his females, who are often vulgar in the extreme: a circumstance said to have been occasioned by an injudicious selection from Flemish women; and amongst others the portrait of his own wife, with light hair, and chubby features, contrasted with his own dark countenance, is not unfrequent in his pictures.

Rubens is thought to have advanced the art of coloring to the greatest degree of perfection; and from his knowledge of *chiaro-scuro* he was enabled to impart the highest harmony to his compositions. He produced also the greatest transparency with extraordinary depth of tone, and in splendour of coloring he is supposed to be unrivalled.

Rembrandt has deviated more from the simplicity of nature than any other artist in his historical compositions. His splendid mannerism cannot be recommended to the emulous student, though from his extraordinary richness, united with powerful effect, criticism is partly disarmed and the judgment taken captive, even while violations of grace, perspective, and anatomy are glaringly obvious. His style indeed is a marvellous extravagance in art.

Raphael appears not to have been actuated by any desire to astonish or excite wonder. He produces the beautiful and the sublime without any apparent effort. Alluding to Raphael, it is well said by Sir Martin A. Shee, "that great painter's merits are among the most elevated and essential; his defects among the most pardonable and unimportant. In his works we find the strongest indications of sound judgment, united to the purest examples of good taste. He never suffers himself to be seduced from *simplicity* to ostentation—never strides beyond the pace of propriety, nor swells beyond the measure of proportion. His inventions, without being obvious or familiar, are natural and probable—neither straining after the eccentric, nor rejecting the uncommon. In his composition, he displays skill and arrangement, without the appearance of artifice, and produces the grace of variety without the affectation of contrast. He resorts to no scholastic pedantries of taste, makes use of no mechanical substitutes for skill, introduces no supplementary figures in theatrical attitudes to fill up space. All is plain and unpretending; his simplicity is without insipidity, his grandeur without inflation. His groups are not constructed according to any mechanical system, nor to academical receipt. No painter ever like him knew how to cover, with the semblance of happy incident, the most studied arrangements of science."

Grandeur in composition, by its elevation of character, startles the mind and enforces respect; yet, after having contemplated the vigorous style of Michael Angelo, the graceful style of Corregio, or the elegant style of Parmeggiano, as soon as our astonishment has subsided, we feel a desire for that tranquillity experienced from contemplating a style characterized by simplicity. There is a charm in this style of irresistible power, which soothes while it takes possession of the feelings, and solicits investigation.

Whatever is beautiful will communicate pleasure, though a state of tranquillity is best suited for the mind to receive those impressions of delight most favorable to improvement. When the judgment is not thus regulated, it surrenders itself to some ideal perfection, some grace beyond the reach of art or of nature, and we place ourselves in a delirium in which beauties may be conceived not evident to correct

taste—an enthusiasm inaccessible to common sense. All this is very remote from simplicity and truth.

Like conversation, painting must be justly expressed to be understood. No sentiment should be so mean as to be unimpressive, nor so refined as to become obscure. A truth simply imparted is very effective; an honest declaration makes its way to the heart, while a pompous appeal risks much in the liability to be misconstrued. It is injured by an ill-chosen word, and ruined by an incongruous thought.

The student ought, from all these considerations, to give his attention to the simple style of historical composition. The term *simple*, though by no means precise as an epithet applied to style, has been adopted in contradistinction to the florid, the affected, or the extravagant, to all of which styles the simple is greatly superior. It embraces a correct outline, harmonious coloring, and chaste effect; impressive and beautiful from the observance of nature and adherence to truth, communicating altogether a satisfaction that makes a lasting impression on the memory.

(To be continued.)

SUBSTITUTE FOR LEATHER.

THIS invention consists in the application of an elastic coating and varnish to substances of a pliable nature, such as all kinds of cloth, whether cotton, linen, woollen, or felt. When the material is required to have flexibility, the composition is to be made of the following ingredients:—

Common glue size	8 parts.
Boiled linseed oil	4 "
Lamp black	1 "
White lead, ground fine	2 "
Pipe clay, ditto	2 "

These are to be melted and well blended together over a fire. At first the size is to be melted, then the oil is to be added in small quantities at a time, next the lamp black, white lead, and pipe clay, during which it should be constantly stirred; the composition is then complete. The cloth being previously strained upon frames, the composition is spread on it evenly and smoothly with a pallet knife, working it well therewith into the interstices of the cloth, so that it shall be thoroughly saturated with the composition. The first coat is then to be dried, either in the air, or in a warm room, by hanging up the frames, care being taken that they be not exposed to much heat. When thoroughly dried and hard, a second coat may be laid on and dried in a similar way; also, a third, a fourth, or a fifth, if required of great substance, which should all be spread on as smoothly, and every successive coat be hard before the next is laid on. This material is chiefly intended for the manufacture of patten ties, and therefore it is cut into strips previously to varnishing it, and passed between polished metal rollers to give them a smooth even surface. Some drying linseed oil, or other suitable varnish is then brushed over the strips; mixing with the varnish any required color to give the article the desired tint. The next operation is the cutting up the material into the usual sizes for patten ties, and finishing the same as usual under a screw-press with dies.

For coach tops, and other purposes where flexibility is not necessary, the quantities of the pipe clay, white lead, and size, may be increased, according to the nature and use of the article to be manufactured of it. For smoothening-down and

polishing such large pieces of the cloth as will not pass through the roller press, the common method of rubbing with pumice stone, tripoli, &c. is adopted previous to varnishing.

SPIRAL VESSELS OF PLANTS.

THE spiral vessels are fine, filmy, and transparent tubes, interspersed occasionally with the other tubes of the plants, but readily distinguished from them by their being twisted in the form of a corkscrew, from right to left, as in the stem of spearmint, or from left to right, as in the stem of fuller's teasel, and terminating in a cone, as it is said. Grew and Malpighi, who first discovered and described them, represented them as resembling in their appearance the *tracheæ* of insects, and designated them by that name—an appellation by which they are still very generally known.

They do not occur often in the root, or, at least, they are not easily detected in it, though Kieser is said to have found them in it, in great abundance. Dutrochet could find none, and denies their existence in the root expressly. They have been repeatedly met with in the root of the lettuce called cos lettuce, though not in any other root that we have ever examined in search of them. Neither are they to be found in the branch or stem of woody plants, except in the annual shoot; nor in the pith of any plant, except in the several species of *nepenthes*. But in the stem and branches of herbaceous plants they are generally to be found without much difficulty, accompanying the longitudinal fibres, and forming part of the bundles. They are very easily detected in the foot-stalk, whether of the leaf or flower. They are discoverable also in the leaf itself; though rarely in the calyx and corolla; and more rarely still in the other parts of the flower. Grew and Malpighi found them both in fruits and seeds. They have been met with in the external umbilical cord of the seed of the cherry, at a very early period of its growth,—that is, about the time of the falling of its petals,—but not in any other fruits. In the leaf or leaf-stalk of the artichoke the spirals are not only remarkably large, but also remarkably beautiful, exhibiting the appearance of spiral coats investing interior fibres, rather than that of a distinct and individual tube, and seeming, when uncoiled, to be themselves formed of a net-like film, consisting of three principal and longitudinal stripes. At present we find that the botanical adepts are divided on this subject, one party contending that the spires are external to the tubes as they appeared in the case just stated; and the other party contending that the spires are, on the contrary, internal, forming a lining to the tubes, and not a coating. Dr. Brown espouses the former opinion, and Professor Henslow espouses the latter.

Is it certain that the organs now under consideration are tubes? In the closely coiled-up state in which they exist in the growing plant, they might be said to constitute tubes by the union of their spires. Divide a leaf-stalk of the artichoke or of the elder longitudinally, cutting it partly, and tearing it partly asunder, and place a portion of it under the microscope. Inspect the exposed surface of it carefully and in a strong light, and it will present to your view bundles of spirals in their coiled-up and united state. Divide a portion of the same leaf-stalk transversely, cutting it partly, and breaking it partly asunder. Place it under the microscope in a clear and strong light, and mul-

titudes of spirals, not yet divided, but merely drawn out, and partly uncoiled, will be found to connect the fractured surfaces; and if you stretch them even till they give way, the fragments will, as if by an elastic and inherent spring, coil themselves up again, nearly as before; yet the prevailing opinion seems to be that the spire does not in any case constitute a tube, but forms merely a coating or lining to a tube within it, or without it.

Much has been said with regard to their functions. Malpighi regarded them as destined to the transmission of air. Grew thought they transmitted not only air, but sap. Mirbel regards them as being well fitted for the transmission of the ascending sap. Mr. Knight thinks they are altogether incapable of transmitting moisture. Yet Hedwig and Senebier concurred in affirming that a fluid may be seen issuing from their orifices, if the horizontal section of a stem is inspected immediately after its division. Hence they are doubtless capable of conducting a fluid, whether it be the ascending sap or not. The latest hypothesis with regard to their function is that of M. Dutrochet. He shows that they cannot be the channel of the sap's ascent, because they do not exist either in the root or stem, except as aforesaid—that is, in the annual shoot. He shows also that they contain a fluid *sui generis*—that is, a diaphanous fluid, which is neither air nor sap. He infers that their function is in accordance with that of the leaves, because it is in the leaves that they occur in the greatest abundance. But leaves are vegetable lungs, and as animals receive a vivifying influence from oxygen in the lungs, so plants, through means of the leaves, receive a vivifying influence from the light of the sun, either directly or in combination with the fluids they contain; which influence the spirals or tracheae convey to the interior, and are hence to be regarded as organs of insolation.

LIQUEFACTION.

ALL bodies are solid, liquid, or gaseous; and the form they assume depends on the relative intensity of cohesion and repulsion. Should the repulsive force be comparatively feeble, the particles will adhere so firmly together, that they cannot move freely upon one another, thus constituting a solid. If cohesion is so far counteracted by repulsion, that the particles move on each other freely, a liquid is formed. And should the cohesive attraction be entirely overcoing, so that the particles not only move freely on each other, but would, unless restrained by external pressure, separate from one another to an almost indefinite extent, an æriform substance will be produced.

Now the property of repulsion is manifestly owing to heat; and as it is easy within certain limits to increase or diminish the quantity of this principle in any substance, it follows that the form of bodies may be made to vary at pleasure: that is, by heat sufficiently intense every solid may be converted into a fluid, and every fluid into vapor. This inference is so far justified by experience, that it may safely be considered as a law. The converse ought also to be true; and, accordingly, several of the gases have already been condensed into liquids by means of pressure, and liquids have been solidified by cold. The temperature at which liquefaction takes place is called the melting point, or point of fusion; and that at which liquids solidify, their point of congelation. Both these points are different for different

substances, but uniformly the same, under similar circumstances, in the same body.

The most important circumstance relative to liquefaction is Black's discovery that a large quantity of heat disappears, or becomes insensible to the thermometer, during the process. If a pound of water at 32° be mixed with a pound of water at 172° , the temperature of the mixture will be intermediate between them, at 102° . But if a pound of ice at 32° be mixed with a pound of water at 172° , it actually loses 140° of heat, all of which enters into the ice, and causes its liquefaction, but without affecting its temperature; whence it follows that a quantity of heat becomes insensible during the melting of ice, sufficient to raise the temperature of an equal weight of water by 140° . This explains the well-known fact, on which the graduation of the thermometer depends, that the temperature of melting ice or snow never exceeds 32° . All the heat which is added becomes insensible, till the liquefaction is complete.

The loss of sensible heat which attends liquefaction seems essentially necessary to the change, and for that reason is frequently called the *heat of fluidity*. The actual quantity of heat required for this purpose varies with the substance, as is proved by the following results obtained by Irvine. The degrees indicate the extent to which an equal weight of each material may be heated by the heat of fluidity which is proper to it.

	Heat of Fluidity.
Sulphur	$143^{\circ} 68^{\circ} \text{ F.}$
Spermaceti	145°
Lead	162°
Bees'-wax	175°
Zinc	493°
Tin	500°
Bismuth	550°

As so much heat disappears during liquefaction, it follows that heat must be evolved when a liquid passes into a solid. This may easily be proved. The temperature of water in the act of freezing remains at 32° , though exposed to an atmosphere in which the thermometer is at zero. That the water under such circumstances may preserve its temperature, heat must be applied as fast as it is abstracted; and it is obvious that the only source of supply is the heat of fluidity. Further, if pure recently boiled water be cooled very slowly, and kept very tranquil, its temperature may be lowered to 21° without any ice being formed; but the least motion causes it to congeal suddenly, and in doing so its temperature rises to 32° .

The explanation which Black gave of these phenomena constitutes what is called his *doctrine of latent heat*. He conceived that heat in causing fluidity loses its property of acting on the thermometer, in consequence of combining chemically with the solid substance, and that liquefaction results, because the compound so formed does not possess that degree of cohesive attraction on which solidity depends. When a liquid is cooled to a certain point, it parts with its heat of fluidity, which is set free or becomes sensible, and the cohesion natural to the solid is restored. The same mode of reasoning was applied by Black to the conversion of liquids into vapours, a change during which a large quantity of heat disappears.

A different explanation of the phenomena was proposed by Irvine. Observing that a solid has a smaller specific heat than the same substance while liquid, he argued that this circumstance alone accounts for heat becoming insensible during lique-

faction. For since the sp. heat of ice and water, or in other words, the quantity of heat required to raise their temperature by the same number of degrees, was found to be as 9 to 10, Irvine inferred that ice must contain one-tenth less heat than water of the same temperature, and that as this difference must be supplied to the ice when it is converted into water, the change must necessarily be accompanied with the disappearance of heat. Irvine applied the same argument to the liquefaction of all solids, and likewise to account for the heat which is rendered insensible during the formation of vapour.

Two objections may properly be urged against the opinion of Irvine. In the first place, no adequate reason is assigned for the liquefaction. It accounts for the disappearance of heat which accompanies liquefaction, but does not explain why the body becomes liquid; whereas the hypothesis of Black affords an explanation both of the change itself, and of the phenomena that attend it. But the second objection is still more conclusive. Irvine argued on the belief that a liquid has in every case a greater sp. heat than when solid; and though this point has not been demonstrated in a manner entirely decisive, yet from the experiments hitherto made, it appears that liquids in general have greater sp. heat than solids, and that therefore Irvine's assumption is probably correct in regard to them. In like manner he believed vapours to have greater sp. heats than the liquids that yield them; but from the fact of most gases having smaller sp. heats than liquids, it is probable that the sp. heats of elastic fluids in general are inferior to those of the liquids from which they are derived. The disappearance of heat during vaporization is not explicable on the views of Irvine; it is necessary to employ the theory of Black to account for that change, and therefore the same doctrine should be applied to the analogous phenomenon of liquefaction.

KERMES.

THERE are two substances so called, of totally different natures. *Kermes mineral* is merely a factitious sulphuret of antimony in a state of impalpable comminution, prepared in the moist way. Its minute examination belongs to pharmaceutical chemistry. It may be obtained perfectly pure, by diluting the proto-chloride of antimony with solution of tartaric acid, and precipitating the metal with sulphuretted hydrogen; or by exposing the finely levigated native sulphuret to a boiling solution of carbonate of potash for some time, and filtering the liquor while boiling hot. The kermes falls down in a brown-red powder as the liquor cools.

Kermes-grains, *alkermes*, are the dried bodies of the female insects of the species *coccus ilicis*, which lives upon the leaves of the *quercus ilex* (prickly oak). The word *kermes* is Arabic, and signifies little worm. In the middle ages, this dye stuff was therefore called *vermiculus*, in Latin, and *vermillon* in French. It is curious to consider how the name *vermillon* has been since transformed to red sulphuret of mercury.

Kermes has been known in the East since the days of Moses; it has been employed from time immemorial in India to dye silk; and was used also by the ancient Greek and Roman dyers. Pliny

speaks of it under the name of *coccigranum*, and says that there grew upon the oak in Africa, Sicily, &c., a small excrescence like a bud, called *cuscuthum*; that the Spaniards paid with these grains half of their tribute to the Romans; that those produced in Sicily were the worst; that they served to dye purple, and that those from the neighbourhood of Emerita in Lusitania (Portugal) were the best.

In Germany, during the ninth, twelfth, thirteenth, and fourteenth centuries, the rural serfs were bound to deliver annually to the convents, a certain quantity of kermes, the *coccus polonicus*, among the other products of husbandry. It was collected from the trees upon St. John's day, between eleven o'clock and noon, with religious ceremonies, and was therefore called *Johannisblut* (St. John's blood), as also German cochineal. At the above periods, a great deal of the German kermes was consumed in Venice, for dyeing the scarlet to which that city gives its name. After the discovery of America, cochineal having been introduced, began to supersede kermes for all brilliant red dyes.

The principal varieties of kermes are the *coccus ilicis*, the *coccus polonicus*, the *coccus fragariae*, and the *coccus urticae*.

The *coccus ilicis* insect lives in the south of Europe upon the kermes oak. The female has no wings, is of the size of a small pea, of a brownish-red color, and is covered with a whitish dust. From the middle of May to the middle of June, the eggs are collected and exposed to the vapour of vinegar, to prevent their incubation. A portion of eggs is left upon the tree for the maintenance of the brood. In the department of the Bouches-du-Rhône, one half of the kermes crop is dried. It amounts annually to about 60 quintals or cwts., and is warehoused at Avignon.

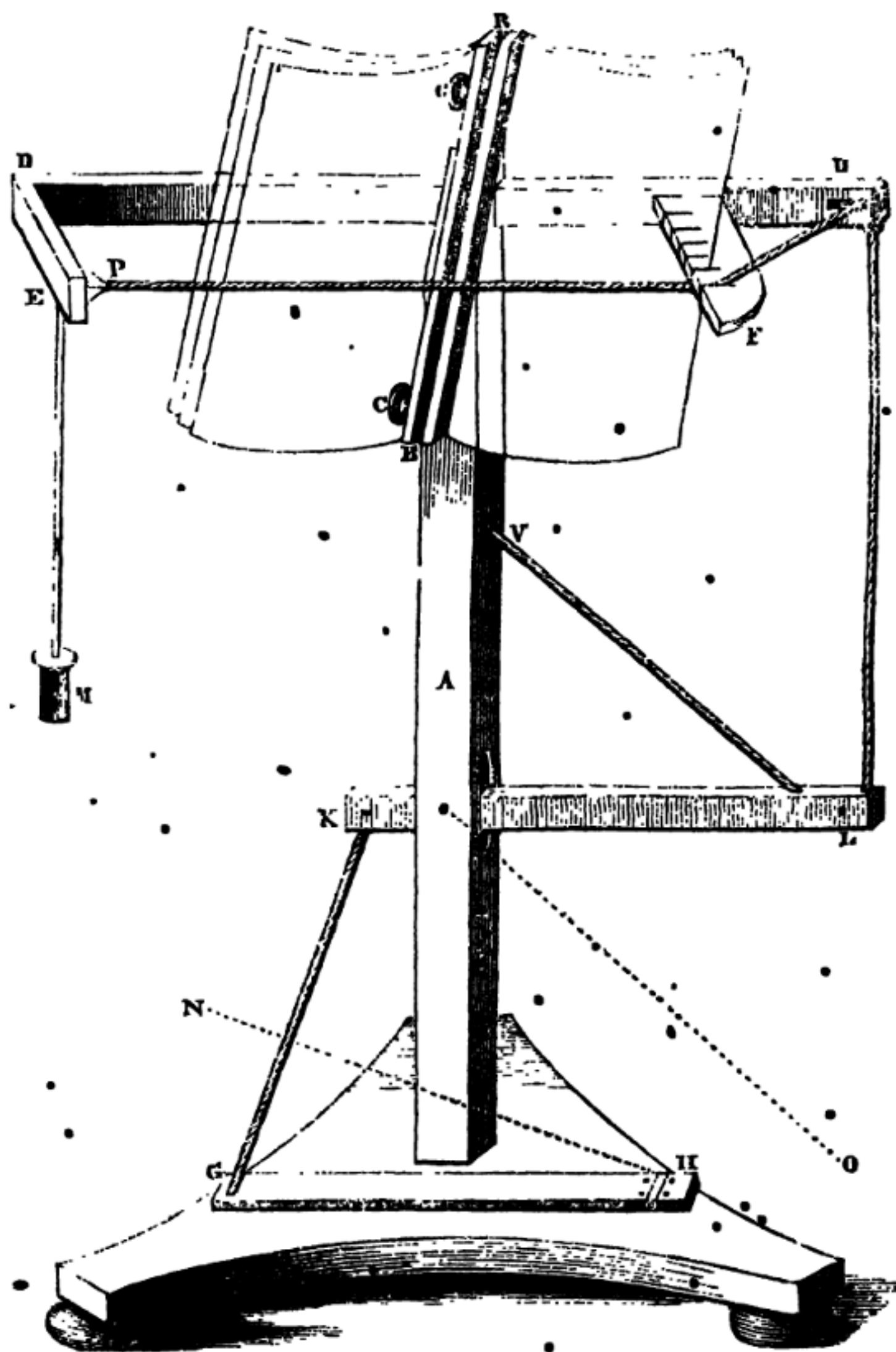
The kermes of Poland, or *coccus polonicus*, is found upon the roots of the *scleranthus perennis* and the *scleranthus annuus*, in sandy soils of that country and the Ukraine. This species has the same properties as the preceding; one pound of it, according to Wolfe, being capable of dyeing ten pounds of wool; but Hermstaedt could not obtain a fine color, although he employed five times as much of it as of cochineal. The Turks, Armenians, and Cossacks, dye with kermes their morocco leather, cloth, silk, as well as the manes and tails of their horses.

The kermes called *coccus fragariae*, is found principally in Siberia, upon the root of the common strawberry.

The *coccus urticae* is twice the size of the Polish kermes, and dyes, with alum, a fine red. It occurs in Russia.

Kermes is found not only upon the *lycopodium complanatum* in the Ukraine, but upon a great many other plants.

Good kermes is plump, of a deep red color, of an agreeable smell, and a rough and pungent taste. Its coloring matter is soluble in water and alcohol; it becomes yellowish or brownish with acids, and violet or crimson with alkalis. Sulphate of iron blackens it. With alum it dyes a blood-red; with copperas, an agate gray; with copperas and tartar, a lively gray; with sulphate of copper and tartar an olive green; with tartar of salt and tin, a lively cinnamon yellow; with more alum and tartar, a lilac; with sulphate of zinc and tartar, a violet.



MACHINE FOR TURNING OVER THE LEAVES OF A MUSIC BOOK.

INSTRUMENT FOR TURNING OVER THE LEAVES OF A MUSIC-BOOK.

BY W. TALBOT AGAR, ESQ.,
(Of Elm Lodge, Cunden Town.)

THIS instrument, in its present form, at least, can be used only in those cases in which the music-book lies on a stand or desk, separate from the musical instrument; as, for example, with the flute, harp, and violin; for it would require considerable modifications to fit it to the use of a performer on the piano-forte or organ, in which the stand to support the book forms part of the musical instrument itself. The apparatus consists of a vertical stem A, forty inches high, on a tripod base, having its upper extremity sloped off at the usual angle of a music desk. On the sloped face is a clamp B B, of which one jaw is fixed, and the other movable; the whole, by means of two thumb-screws C C, being adapted to secure any required piece of music, as indicated by the dotted lines. The horizontal bar D D, has an arm D E, four inches long, and a thin piece of wood F, containing six or more narrow slits, into which are inserted the leaves to be turned over, and which point to, or radiate from, a pulley at E. A pedal-lever G, turning on a hinge at H, acts by the cord G K running in a pulley at K, on the lever K L, which acts in its turn on the cord V L D F P E M, fixed at V, running in a pulley at L, and having at P a three-pronged hook, which cannot fail in moving from F towards E, to catch the edge of the uppermost leaf, remaining at that time in the slits of the piece F. The machine is shown as having just completed a turn; the pedal G is in its lowest, and the arm L in its highest position, their usual places being shown by the dotted lines N and O. The pedal is, in fact, supposed to have the foot on it.

The power to turn the leaf is supplied by the weight M, surmounted by a disk of cork, or a spiral spring, to lessen the violence of the blow on its return against the under side of the piece E, while the contact of the hook P with the same piece E, is prevented by a knot in the cord. The ascent of the weight M, and the consequent retreat of the hook P to its place of rest under F, is caused by a weight (greater than M) at the end of the lever L; thus both movements of the cord are produced by given forces, and are secured against receiving undue violence from the headlessness of the player. The bend in the cord between D and P arises from its being kept outwards at F by the leaves of the music, against which it rubs in its movement backwards and forwards, so that the hook cannot fail to take hold of the upper leaf when required so to do; and the distance between the slits is just sufficient to prevent its engaging two leaves at once.

It is almost needless to add, that there are pulleys at D and E to guide and facilitate the alternations of the cord. There are, also, provisions at the inner extremities of E and F to retain such of the first and last leaves of the music as are not immediately in use. The drawing is made from a machine constructed, experimentally, in wood, but it may, of course, be formed of metal, and is susceptible of any requisite degree of elegance. The line between P and M is of fine transparent gut, for the purpose of lessening the friction against the paper, of assisting the engagement of the hook, and of obscuring as as little as possible the notes on which it may chance to lie. The parts B B, as well as the frame D D, are shown as if in the front of the music, though

in reality, they are at the back of it; so also, the lever K L, may be made so as to be of sufficient weight to counter-balance M, without any additional weight.

ANCIENT DOMESTIC ARCHITECTURE.

(Resumed from page 182, and concluded.)

THE domestic architecture of every country is necessarily affected by the degree of safety in which that country may be, consequently, in the north of England, from the early part of the fourteenth century down to the union of the two crowns of England and Scotland under one monarch, James I, or nearly to that time, no residence was safe except a tower, (some rectory houses are yet towers,) so that for what may strictly be termed "domestic" architecture during the fourteenth century, it is in vain to search there; but there are many border towers, as they are termed, and many of great interest; Belsay Castle is the finest. They all, or at least nearly all, preserve the aboriginal feature of having the lower story vaulted like the twelfth century houses; and in Chillingham Park, Northumberland, is Hepburn Tower, which still more accurately preserves at the end of the fourteenth century, or perhaps rather later, the features of a house of the twelfth century; it is nearly square, has the lower story vaulted, and had *originally* (for the staircase has clearly been thrust in since) no internal communication between the upper and lower story; the fire-places (five in number) are in the upper story and attics.

With respect to houses in towns during this century there are in York some remarkable specimens of foot entrances from the street, to courts which appear to have been in common to several houses. They are chiefly remarkable from the enormous length of the spurs forming the two sides of the entrance, and supporting the projecting story of the house above, or rather supporting a projection beyond that projecting story. This taste in York continued until late in the fifteenth century, and the spurs are then very richly carved. There are perhaps no other specimens of them, at least not carried to the extent they are there. It is impossible, from the multiplicity of remains in this century, to do any thing like justice to the matter in a mere outline like this. There are timber houses of the fourteenth century yet remaining, but of course the details are much destroyed; they exist at York and Salisbury, at Wingham, Kent, and there is one or part of one at Colchester. Single doors, &c. occur in other places. It is probable that there exist halls of this century in some of the timber houses in Cheshire, but we have not seen them.

In the fifteenth century, houses of all materials, plans, and sizes, occur; sometimes quadrangular, as at Thame Prebendal House, though part earlier; sometimes a large irregular court, formed partly by the house, by stables and other out-buildings, and by walls, as (late in the century) Great Chalfield, Wilts. Until rather late in the century it is not however easy to find an entire house of any size all of one date. The fronts of Ockwells, Berks; Great Chalfield, Wilts; and Harlaxton, Lincolnshire, (the latter amidst much later work) exhibit a singular uniformity of design; at each end are two large gables, then two small ones, one forming the porch, the other the hall window, and the centre of the building between these two small gables consists of a recess forming the hall. Of that recess hereafter.

Towards the end of the century tower gateways, sometimes square (used earlier also) and sometimes with octangular towers on each side, were used for the entrance. Moats were still in use through this century, but not to every house; it is not improbable that sometimes the moat may have belonged to an older house than the existing one. In the northern counties, border towers were still in use by the smaller proprietors; and castles, possessing features both of habitation and fortification, by the greater lords; of these last, Warkworth is by far the finest; the whole of the lower story is vaulted, the chief rooms being above. In many towns are considerable remains of houses built during the fifteenth century; many of them originally inns, and some still so. A house in the market-place, Newark, is an early instance (Ed. IV.) of timber and ornamental plaister or cement united, of which latter material are a series of figures with canopies; here, as in many other timber houses in towns, a long range of windows, or rather one window extending through the whole front, occurs. In some towns are to be found houses, the lower stories of which appear to have been originally intended for shops, from their having arcades of stone or timber, originally apparently open.

Nothing has yet been said of the mode in which houses were fitted up in the interior, as but little evidence on this head is to be found until late in this century. Hall screens are occasionally to be found rather earlier, but not much so. Tapestry of course must have been in use, but specimens even so late as the end of this century are not common, and we believe none occur earlier. The walls were also occasionally painted with ornaments or figures; indeed remains of this are to be found at a much earlier period, as the celebrated Painted Chamber in the Palace of Westminster. It is probable that wainscot also began to be used at the end of this century, but any observations on it may be postponed until the next century. It is not easy to speak of the ciellings during this century; at Sherborne Abbey, Dorset, is a good timber one divided into squares with flowers carved at the intersections; the hall at Great Chalfield had its cielling divided into squares by the main timbers, and those squares subdivided into others of plaister, with bosses at the intersections.

During the sixteenth century there arose many houses of great magnificence, of all plans and materials, and ample remains of which yet exist.

Of course from the middle down to the close of this century Italian features were continually increasing, and consequently the style which was in use at the end of the century varied very materially from that used at the beginning. Early in this century, if not sooner, wainscot came much into use for the principal rooms. The panels were small, and most of what is called the linen pattern, being more or less in imitation of folds of linen; but they were also carved with every variety of pattern, mixed more less with Italian details, and frequently the upper line of panels of the room had carved in high relief fanciful heads placed in wreaths. Hainaker in Sussex, when standing, was very rich in this sort of work. A great deal yet remains elsewhere, as at Tolleshunt Darcy, Essex; Thame Park, Oxon; Boughton Malherbe, Kent; a house built by Sir Antony Wingfield, Ipswich, (now the Magpie); Syon House, Middlesex; and so in many other places more or less. At Compton Wyniate, Warwickshire, is a room, the walls of which are

lined with oak boards, not panelled but closely fitted, with carving round the door and up the angles, and a cornice. In the principal room (up stairs) of a timber house, Pattenden, near Goudhurst in Kent, the walls and ciellings are lined with oak boards reeded with the mouldings of the linen pattern, but not panelled. In one of the other rooms in the same house there was a cielling similar to that before mentioned at Sherborne Abbey. In halls and lofty rooms the wainscoting was only about eight feet high. Towards the latter end of the century plainer panels were introduced, with sometimes gilding, as at a house at Hollingborne, Kent, and also arabesques, &c. in painting, as at Boughton Malherbe, Kent. These particular panels at this last place are of deal, which is an early use of that material. Sometimes the walls had rude paintings, as at Eastbury House, Essex. The ciellings were frequently very richly ornamented; in the early part of the century the main divisions were formed by the girders of the floor above, and those spaces subdivided by plaister ribs slightly raised, as at Thame Park; sometimes the girders and joints of the floor above were left bare, but ornamented by mouldings, and occasionally richly carved, as at a house in Colchester, now the Marquis of Granby public house. The room in the house before mentioned at Ipswich (Magpie) has a very rich cielling of pendants. Sometimes the ciellings were divided into various figures by ribs of oak, and the spaces between plaistered; as at Layer Marney, Essex; Hever and Allington Castles, Kent. In later times these ribs were of plaister, and much ornamented. No ornamental staircases yet occur, unless it be towards the end of the century; where in this century they exist of such a form as according to the taste of later days would have required a baluster, the space below the hand-rail is usually filled up with plaister instead of having an open balustrade, as at Boughton Malherbe, and Leeds Castle, Kent. It was not until late in this century that the chimney-piece was carried up the whole height of the room, and had every species of ornament lavished on it.

In the early part of this century, and perhaps late in the last, the usual plan of the timber houses of the yeomen and small gentry in Kent and Sussex, and perhaps other counties, appears to have been this:—The upper story projected at each end, the centre forming a recess between them; that centre formed a hall, which was open to the roof, and had no fire-place, as the roof is not unfrequently covered with a thick coat of hardened wood soot. A century later floors were inserted in the hall, and a chimney built. This is a reduced specimen of the general plan of Great Chalfield, &c. before mentioned, and that plan is certainly the origin of the E and H houses, which had the hall in the centre recess, and were continued down into the eighteenth century. Galleries appear to have been not generally in use before the latter part of this century. The timber houses in Shrewsbury of this century and down to the end of it display an unusually late adherence to Gothic forms in their details; they are of course flat in execution. The timber houses in towns during the latter part of this century are often very splendid.

Houses of the seventeenth century hardly require description, they are so well known. Staircases, such as Lord Bacon describes in his "Essay on Building," with open balustrades, came into use, and many of them very handsome. Galleries also in the large houses. The workmanship however of the time of James I. and Charles I. is frequently inferior

to that of Elizabeth's time, especially as to carving and ornamental plaister work. Towards the middle of the century houses with high roofs and bold cornices on large projecting brackets are occasionally found, as Balls in Hertfordshire, but they were not thoroughly established until late in the century. In the latter part of this century houses of plaister very richly ornamented were frequent in towns. Of these, Sparrow's House at Ipswich is the most splendid specimen. They occur at Maidstone, Canterbury, and many other places. One of the richest timber houses to be found of this period is at Ludlow. During this century also, in the garden, terraces with balustrades of open panels, and having animals at the angles, were frequently used and have a very striking effect; witness Claverton, Somersetshire, and the Duke's House, Bradford, Wilts.

Lastly, it is worthy of remark, that down to the beginning of the eighteenth century and even some way into it, the plan of having the chief room up stairs was not unfrequently still continued; thus retaining to a very late period so much of the arrangement of the twelfth century house, although the original reason for that arrangement had long ceased; but it was probably continued for purposes of state, especially so long as the staircase leading to the chief room formed a handsome feature of the house. The arrangement however was sometimes retained even in smaller houses.

TRANSFERRING ENGRAVINGS.

BY MR. REDMAN,

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THE object aimed at is to make a transfer of copper-plate engraving to zinc, retaining, at the same time, the whole, or nearly the whole, of its original sharpness and distinctness. The same process may be applied to making a retransfer from stone to stone or zinc, and thus obtaining two or more plates of the same subject; which has been found to be a great advantage when a great number of impressions are required, or a smaller number in a shorter time than can be taken off from a single plate or stone.

The first part of the process consists in taking an impression from the copper-plate in the usual way, but with a peculiar ink, on transfer paper peculiarly prepared. The composition of this ink is as follows:—3 ozs. of shell-lac, 1 oz. of mastic, 1½ oz. of yellow bees' wax, ½ oz. of tallow, 4 ozs. of hard curd soap, and lamp-black enough to color it. The above ingredients are to be mixed together most intimately, and are then to be burnt in a pipkin for ten minutes, stirring the mass carefully all the time. The residuum by exposure to the air becomes damp; so that by pounding it in a mortar it concretes into a paste of a very stiff consistence, and in this state is called *hard ink*. One part of this hard ink, rubbed and ground with two parts of common stiff lithographic ink, forms the transfer ink; which being applied to the surface of an engraved copper-plate in the usual way, gives an accurate impression to prepared transfer paper.

The latter is prepared as follows:—One quarter of a pound of the best flour is to be mixed with common porter, in such proportion that it shall form, by boiling, a thin paste of a perfectly uniform consistence; which paste is to be laid quite evenly on the smooth surface of a sheet of India paper, and is to be dried gradually. The impression being obtained on this prepared paper, it is to be trans-

ferred in the usual way to a smooth plate of zinc. When the zinc has received the transferred impression, it is to be covered with an infusion of nut-galls, in the proportion of one ounce of galls to half a pint of water, the mixture to be then simmered for ten minutes in any vessel not of iron. The liquor is to be left on the plate for from five to ten minutes, its effect being to neutralise the alkali of the transfer ink, and thus to harden it and prevent it from spreading when sponged with water previous to printing from it.

MANUFACTURE OF HORN.

IN the English language we have only one word to express two quite different substances—namely, the branched bony horns of the stag genus and the simple laminated horns of the ox genus, and other kindred genera. The bony horns are called in French *bois*, from their likeness to the branch of a tree; they are annually renewed, and are peculiar to the male sex, except in the reindeer, the females of which likewise have horns, though not nearly so large as those of the male. The other sort of horn, to which the French appropriate the term *corne*, and which is the subject of our present inquiry, is found in the ox, the antelope, the goat and sheep kinds. These are never branched or palmated, but are always of a simple conical figure, more or less curved, and, in some of the antelopes, spirally twisted; they are found in both sexes, but, in the goats and sheep, are much larger in the male than in the female.

Almost the only kinds of horn that are the subject of manufacture are those of the bull and cow, and the hoots of these animals; the horns of the bullock being thin, and of a very coarse texture, are used only for the most ordinary purposes. Our domestic supply is by no means equal to the demand, so that great quantities are imported from Russia, the Cape of Good Hope, and South America.

The first process is the separation of the true horn from the bony core on which it is formed; for this purpose the entire horns are macerated in water for a month or six weeks, according to the temperature; during this time the membrane which lies between the core and the horn is destroyed by putrefaction, so that the core becomes loose, and can be easily extracted. The cores are not thrown away, but are burnt to ashes, and in this state form the best material for those small tests or cups employed by the assayers of gold and silver.

The next process is to cut off with a saw the tip of the horn, that is, the whole of its solid part, which is used by the cutlers for knife-handles, is turned into buttons, and is applied to sundry other purposes. The remainder of the horn is left entire or is sawn across into lengths, according to the use to which it is destined. Next, it is immersed in boiling water for half an hour, by which it is softened; and, while hot, is held in the flame of a coal or wood fire, taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept here till it acquires the temperature of melting lead or thereabouts, and, in consequence, becomes very soft. In this state it is slit lengthways by a strong-pointed knife, like a pruning-knife, and, by means of two pairs of pincers applied one to each edge of the slit, the cylinder is opened nearly flat. These flats are now placed on their edges between alternate plates of iron, half an inch thick and eight inches square,

previously heated and greased, in a strong horizontal iron trough, and are powerfully compressed by means of wedges driven in at the ends. The degree of compression is regulated by the use to which the horn is to be afterwards applied; when it is intended for leaves of lanthorns, the pressure is to be sufficiently strong (in the language of the workmen) to break the grain; by which is meant separating, in a slight degree, the laminæ of which it is composed, so as to allow a round-pointed knife to be introduced between them, in order to effect a complete separation.

The plates thus obtained are laid one by one on a board covered with bull's hide, are fastened down by a wedge, and are then scraped with a draw-knife having a wire-edge turned by means of a steel rubber; when reduced to a proper thickness and smoothed, they are polished by a woollen rag dipped in charcoal dust, adding a little water from time to time, then are rubbed with rotten-stone, and finished with horn shavings. The longest and thinnest of the films cut off by the draw-knife, when dyed and cut into various figures, are sold under the name of sensitive Chinese leaves (being originally brought from China,) which, after exposure to a damp air, will curl up as if they were alive when laid on a warm hand or before the fire.

For combs, the plates of horn should be pressed as little as possible, otherwise the teeth of the comb will split at the points. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw; the teeth are cut by a double saw fixed in a back, the two blades being set to different depths, so that the first cuts the tooth only half way down, and is followed by the other which cuts to the full depth; the teeth are then finished and pointed by triangular rasps. If a comb or other article is too large to be made out of one plate of horn, two or more may be joined together by the dexterous application of a degree of heat sufficient to melt but not decompose the horn, assisted by a due degree of pressure; and when well managed the place of juncture cannot be perceived. The Chinese are remarkably skilful in this kind of work, as may be seen in the large globular lanthorn in the Museum in the East India House, about four feet diameter, composed entirely of small plates of colored and painted horn. Horn combs are made in London, in York, and in many other English towns; but the chief manufactory of them is at Kenilworth, in Warwickshire. If a work in horn, such as one of the large combs worn by women, is required to be of a curved or wavy figure, it is finished flat, and is then put into boiling water till it becomes soft and is immediately transferred to a die of hard wood, in which it is cautiously pressed, and remains there till cold.

Horn combs ornamented with open work are not made in this country, because the expense of cutting them would be more than the price of the article would repay; but great numbers of them are imported from France. These, however, are not cut, but pressed in steel dies made in London for the French manufacturers; and from an examination of these combs, it is evident that the material must have been in a soft state, approaching to fusion, when put into the die. On referring to French authorities, we shall find it stated, that horn steeped for a week in a liquor, the active ingredient of which is caustic fixed alkali, becomes so soft that it may easily be moulded into any required shape. Horn shavings subjected to the same process become

semi-gelatinous, and may be pressed in a mould into the form of snuff-boxes and other articles. Horn, however, so treated becomes hard and very brittle, probably in consequence of its laminated texture being obliterated by the joint action of the alkali and strong pressure. Drinking cups of horn are thus made:—The horn being sawn to the required length is scalded and roasted over the fire, as already described; but instead of being slit and opened, is placed while hot in a conical mould of wood; a corresponding plug of wood is then driven hard in, to bring the horn to shape. Here it remains till cold, and is then taken out and fixed by the large end on the mandril of a lathe, where it is turned and polished both inside and outside, and a groove, or chime as the coopers call it, is cut by a gage-tool within the small end for receiving the bottom. The horn is then taken off the lathe and laid before the fire, where it expands and becomes somewhat flexible; a round flat piece of horn, of the proper size (cut out of a plate by means of a kind of crown-saw,) is dropped in, and forced down till it reaches the chime, and becomes perfectly fixed in this situation and water-tight by the subsequent contraction of the horn as it cools. Capt. Magdold informs us, that he has seen in South America a nest of such cups turned to a thickness not exceeding that of a card, and accurately fitting into each other, the outer one holding about a pint and the inner one little more than an ounce.

Horn is easily dyed by boiling in it infusions of various coloring ingredients, as we see in the horn lanthorns made in China. In Europe it is chiefly colored of a rich red brown, to imitate tortoiseshell, for combs and inlaid work. The usual mode of effecting this is to mix together pearlash, quicklime, and litharge, with a sufficient quantity of water and a little pounded dragon's blood, and boil them together for half an hour. The compound is then to be applied hot on the parts that are required to be colored, and is to remain on the surface till the color has struck; on those parts where a deeper tinge is required, the composition is to be applied a second time. For a blacker brown, omit the dragon's blood. This process is nearly the same as that employed for giving a brown or black color to white hair; and depends on the combination of the sulphur, which is an essential ingredient in albumen, with the lead dissolved in the alkali, and thus introduced into the substance of the horn.

ANALYSIS OF SOILS.

In selecting specimens, where the general nature of the soil is to be ascertained, portions of it should be taken from different places, two or three inches below the surface, and examined as to the similarity of their properties. It sometimes happens, that upon plains, the whole of the upper stratum of the land is of the same kind, and in this case, one analysis will be sufficient; but in valleys, and near the beds of rivers, there are very great differences, and it now and then occurs that one part of the surface is calcareous, and another part siliceous; and in this case, and in analogous cases, the portions different from each other should be separately submitted to experiment. Soils, when collected, if they cannot be immediately examined, should be preserved in phials quite filled with them, and closed with ground glass stoppers. The quantity of soil most convenient for a perfect analysis is from two to four hundred grains. It should be collected in

dry weather, and exposed to the atmosphere till it becomes dry to the touch.

The soil best suited for culture, according to the analysis of Bergman, contains four parts of clay, three of sand, two of calcareous earth, and one of magnesia; and, according to the analysis of Fourcroy and Hassenfratz, 9216 parts of fertile soil contained 305 parts of carbon, together with 279 parts of oil; of which, according to the calculations of Lavoisier, 220 parts may be regarded as carbon; so that the whole of the carbon contained in the soil in question may be estimated at about 525 parts, exclusive of the roots of vegetables, or to about one sixteenth of its weight. Young observed that equal weights of different soils, when dried and reduced to powder, yielded by distillation, quantities of air somewhat corresponding to the ratio of their values. The air was a mixture of fixed and inflammable airs, probably derived from the decomposition of water, either by the chemical affinities of the ingredients of the soil, or by the process of vegetation, while the carbonic acid or fixed air may be absorbed from the atmosphere, or produced by living vegetables under certain circumstances. Kirwan has shown in his "Geological Essays," that the fertility of a soil depends in a great degree upon its capacity for retaining water; and if so, soils containing the same ingredients must be also equally fertile, all other circumstances being the same, though it is plain that their actual fertility will depend ultimately upon the quantity of rain that falls, because the quantity suited to wet a soil cannot be the same that is suited to a dry soil; and hence it often happens that the ingredients of the soil do not correspond to the character of the climate. Silica exists in the soil under the modification of sand, and alumine under the modification of clay; but the one or the other is often to be met with in excess or defect. Soils in which the sand preponderates retain the least moisture, and soils in which the clay preponderates retain the most; the former are dry soils, the latter are wet soils; but it may happen that neither of them is sufficiently favorable to culture; in which case, their peculiar defect or excess must be supplied or retrenched before they can be brought to a state of fertility.

In the present state of chemical science, no certain system can be devised for the improvement of lands, independent of experiment; but there are few cases in which the labor of analytical trials will not be amply repaid by the certainty with which they denote the best methods of melioration; and this will particularly happen, when the defect of composition is found in the proportions of the primitive earths. In supplying organic matter, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops; but when a soil is rendered of the best possible constitution and texture, with regard to its earthy parts, its fertility may be considered as permanently established. It becomes capable of attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labor and expense by stirring the soil, and a proper succession of crops.

The physical properties of soils, and some of their most important constituents relatively to the cultivator, may be ascertained to a certain extent by various and very simple means.

The specific gravity of a soil, or the relation of its weight to that of water, may be ascertained by introducing into a phial, which will contain a known

quantity of water, equal volumes of water and of soil, and this may be easily done by pouring in water till it is half full, and then adding the soil till the fluid rises to the mouth; the difference between the weight of the soil and that of the water will give the result. Thus, if the bottle contains four hundred grains of water, and gains two hundred grains when half filled with water and half with soil, the specific gravity of the soil will be 2, that is, it will be twice as heavy as water, and if it gained one hundred and sixty-five grains, its specific gravity would be 1.825, water being 1000.

The presence of clay and sand in any soil is known, the first by its tenacity, the other by its roughness to the touch, and by scratching glass when rubbed on it.

The presence of calcareous matter in soil may be ascertained by simply pouring any acid on it, and observing if it effervesces freely. Muriatic acid is the best for this purpose. Calcareous soils, magnesian soils, and clays, are, for the most part, softer to the touch than arenaceous soils. To ascertain the quantity of calcareous earth present, dry soil thoroughly, and weigh 100 grains of it, which gradually add to one drachm of muriatic acid diluted with two drachms of water in a phial poised in a balance; the loss of weight will indicate the escape of carbonic acid, which will be 44 per cent. of the quantity of calcareous earth in the soil.

The presence of organised matter in any soil may be ascertained very satisfactorily by weighing it after it is thoroughly dried; then subjecting it to a red heat and weighing it again, the weight so found will be the proportion of organic matter and carbonic acid gas, if there should have been any. The same object may also be attained by ascertaining the specific gravity of the soil, but with less accuracy.

The presence of metallic oxides in a soil may generally be known by their color. Ferruginous soils are red or yellow; cupreous soils, interspersed with greenish streaks, &c. Cupreous impregnations of soils are rare; and the usual green matter in such soils as the *green sand* of English geologists, appears to be colored by iron, which is almost the only metallic impregnation in considerable quantity in any soil.

The presence of salt, sulphur, coal, &c., may be known by the absence or peculiarity of vegetation, as well as by color, and the appearance of the water of such soils. Saline soils may be distinguished by the taste; sulphureous soils by their smell when thrown on a hot iron; and the presence of coal by its fragments, which will be left after the soluble matters are removed by water and muriatic acid.

The capacity of a soil for retaining water may be thus ascertained:—An equal portion of two soils, perfectly dry, may be introduced into two tall glass cylindrical vessels, in the middle of each of which a glass tube has been previously placed. The soils should be put into each in the same manner, not compressed very hard, but so as to receive a solidity approaching to that which they possessed when first obtained for trial. If, after this preparation, a quantity of water be poured into the glass tubes, it will subside; and the capillary attraction of the soils will conduct it up the cylinders towards the tops of the vessels. That which conducts it most rapidly, provided it does not rise from the weight of the incumbent column of water in the tube, may be pronounced to be the better soil.

MEDICAL MECHANICS.

There is scarcely a part of the animal body, or an action which it performs, or an accident that can befall it, or a piece of professional assistance which can be given to it, that does not furnish illustration of some truth of natural philosophy.

The cranium or skull may be mentioned as an instance of the arched form answering the purpose of giving strength. The brain, in its nature, is so tender or susceptible of injury, that slight local pressure disturbs its action. Hence a solid covering like the skull was required, with those parts made stronger and thicker which are most exposed to injury. An architectural dome is constructed to resist one kind of force only, always acting in one direction, viz. gravity; and therefore its strength increases regularly towards the bottom, where the weight and horizontal thrust of the whole are to be resisted; but in the skull, as in a barrel or egg-shell, the mere tenacity of the substance is many times greater than sufficient to resist gravity, and therefore the form and securities are calculated to resist forces of other kinds operating in all directions. When we reflect on the strength displayed by the arched film of an egg-shell, we need not wonder at the severity of blows which the cranium can withstand. A very severe partial blow on the skull generally fractures and depresses the part, as a pistol-bullet would; while one less severe, but with more extended contact, being slowly resisted by the arched form, often injures the skull, by what is correspondent to the horizontal thrust in a bridge, and causes a crack at a distance from the place struck,—generally half-way round to the opposite side. The French in speaking of this effect use the term *contre-coup*. Sometimes in a fall with the head foremost, the skull would escape injury, but for the trunk which falls upon it, and drives the end of the spine against or even through its base.

In the lower jaw we have to remark the greater mechanical advantage, or lever-power, with which the muscles act, than in other parts of animals. The temporal and masseter muscles pull almost directly, or at right angles to the line of the jaw, while in most other cases, as in that of the deltoid muscle lifting the arm, the muscles act very obliquely, and with power diminished in proportion to the obliquity. An object placed between the back teeth is compressed with the whole direct power of the strong muscles of the jaw. Hence the human jaw can crush a body which offers great resistance, and the jaws of the lion, tiger, shark, and crocodile, &c. are stronger still.

The teeth rank high among those parts of the animal body, which appear almost as if they were severally the results of distinct miraculous agencies—so difficult is it to suppose a few simple laws of life capable of producing the variety of form and fitness which they exhibit. They constitute a beautiful set of chisels and wedges, so arranged as to be most efficient for cutting and tearing and grinding the food, with their exterior enamel so hard, that few substances in nature can make an impression upon it. In early states of society, teeth were used for many purposes for which steel is used now. It seems, however, as if the laws of life, astonishing to human intellect as they are, had still been inadequate to cause teeth cased in their hard and polished enamel, to grow as the softer bones grow; and hence has arisen a provision more extraordinary still. A set of small teeth appear soon

after birth, and serve the child until six or seven years of age; these then fall out, and are replaced by larger ones, which endure for life; the number of the latter, however, being completed only when the man or woman is full grown, by the four teeth, called wisdom teeth, from coming with the person's maturity, to fill up the then spacious jaw.

The spine or back bone, in its structure, has as much of beautiful and varied mechanism as any part of our wonderful frame. It is the central pillar of support and great connecting chain of all the other parts; and has, at the same time, the office of containing within itself, and of protecting from external injury, a prolongation of the brain, called the spinal marrow, more important to animal life than the greater part of the brain itself. It has united in it the apparent incompatibilities of great elasticity, great flexibility in all directions, and great strength, both to support a load and to defend its important contents.

The shoulder-joint is remarkable for combining great extent of motion with great strength. The round head of the shoulder-bone, that it may turn freely in all ways, rests upon a shallow cavity or socket in the shoulder-blade; and the danger of dislocation from this shallowness is guarded against by two strong bony projections above and behind. To increase the range of motion to the greatest possible degree, the bone called the shoulder-blade, which contains the socket of the arm, slides about itself upon the convex exterior of the chest, having its motion limited in certain directions by its connexion, through the collar-bone or clavicle, with the sternum.

The scapula or blade-bone is extraordinary as an illustration of the mechanical rules for combining lightness with strength. It has the strength of the arch from being a little concave, and its substance is chiefly collected in its borders and spines, with thin plates between, as the strength of a wheel is collected in its rim, and spokes, and nave. The bones of the arms, considered as levers, have the muscles which move them attached very near to the fulcrum, and very obliquely, so that the muscles, from working through a short distance comparatively with the displacement of the resistances at the extremities, require to be of great strength. It has been calculated that the muscles of the shoulder-joint, in the exertion of lifting a man upon the hand, pull with a force of two thousand pounds.

The elbow joint is a correct hinge, and so strongly secured that it is rarely dislocated without fracture.

The fore arm consists of two bones with a strong membrane between them. Its great breadth, from this structure, affords abundant space for the origin of the many muscles which go to move the hand and fingers; and the very peculiar mode of connexion of the two bones, gives man that most useful faculty of turning the hand round, into what are called the positions of pronation and supination,—exemplified in the action of twisting, or of turning a gimblet.

The wrist.—The many small bones forming the wrist have a signal effect of deadening, in regard to the parts above, the shocks or blows which the hand receives.

The annular ligament is a strong band passing round the joint, and keeping all the tendons which pass from the muscles above to the fingers, close to the joint. It answers the purpose of so many fixed pulleys for directing the tendons; without it, they would all, on action, start out like bow-strings, producing deformity and weakness.

The human hand is so admirable, from its numerous mechanical and sensitive capabilities, that an opinion at one time prevailed, that man's superior reason depended on his possessing such an instructor and such a servant. Now, although reason, with hoofs instead of fingers, could never have raised man much above the brutes, and probably could not have secured the continued existence of the species,—still the hand is no more than a fit instrument of the god-like mind which directs it.

The pelvis, or strong irregular ring of bone on the upper edge of which the spine rests, and from the sides of which the legs spring, forms the centre of the skeleton. A broad bone was wanted here to connect the central column of the spine with the lateral columns of the legs, and a circle was the lightest and strongest. If we attempt still farther to conceive how the circle could be modified so as to fit it—for the spine to rest on, for the thighs to roll in, for muscles to spring from, both above and below, for the person to be able to sit, &c., we shall find, on inspection, that all our anticipations are realized in the most perfect manner.

The hip joint exhibits the perfection of the ball and socket articulation. It allows the foot to move round in a circle, as well as to have the great range of backward and forward motion, exhibited in the action of walking.

The thigh bone is remarkable for its two projections near the top, called trochanters, to which the moving muscles are fixed, and which lengthen considerably the lever by which the muscles work. The shaft of the bone is not straight, but has a considerable forward curvature. Short-sightedness might suppose this a weakness, the bone being a pillar to support a weight; but the bend gives it in reality the strength of the arch, to bear the action of the mass of muscles called *vastus*, which lies and swells upon its fore part.

The knee is a hinge joint of complicated structure, claiming the most attentive study of the surgeon. The rubbing parts are flat and shallow, and therefore the joint has little strength from form; but it derives security from the numerous and singularly strong ligaments which surround it. The ligaments on the inside of the knees resemble, in two circumstances, the annular ligaments of joints, viz. in having a constant and great strain to bear, and yet in becoming stronger always as the strain increases. The line of the leg, even in the most perfect shapes, bends inwards a little at the knee, requiring the support of the ligaments; and in many persons it bends very much; but the inclination does not increase with age. The legs of many weakly in-kneed children become straight by exercise alone. This inclination at the middle joint of the leg, by throwing a certain strain on the ligaments, gives, in such actions as jumping, running, &c., an increase of elasticity to the limb. The leg below the knee, like the fore-arm already described, has two bones. They offer spacious surface of origin for the numerous muscles required for the feet, and they form a compound pillar of greater strength than the same quantity of bone as one shaft would have had. The individual bones also are angular instead of round, hence deriving greater power to resist blows, &c.

The ankle-joint is a perfect hinge of great strength. There is in front of it an annular ligament, by which the greater part of the tendons passing downwards

to the foot and toes are kept in their places. One of these tendons passes behind and under the bony projection of the inner ankle, in a smooth appropriate groove, exactly as if a little fixed pulley were there.

The heel, by projecting so far backwards, is a lever for those strong muscles to act by, which form the calf of the leg and terminate in the tendo achillis. The muscles, by drawing at it, lift the body, in the actions of standing on the toes, walking, dancing, &c. In the foot of the negro the heel is so long as, in European estimation, to appear ugly; and its great length rendering the effort of smaller muscles sufficient for the various purposes, the calf of the negro's leg is smaller than of other races of men.

GRADUATION OF THERMOMETERS.

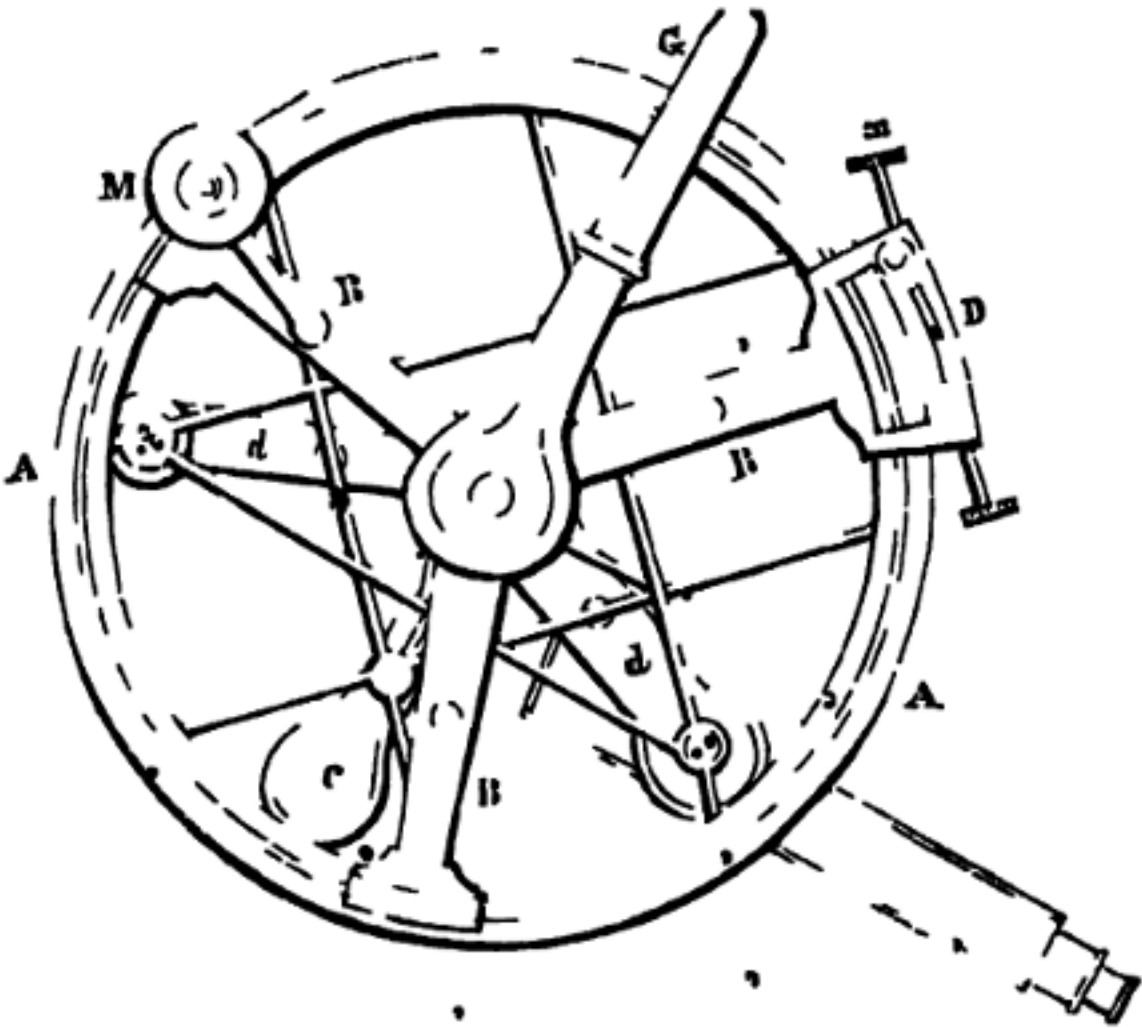
It has commonly been alleged that at the time when Roemer's or Fahrenheit's scale was proposed, its zero was derived from the artificial cold produced by a mixture of salt and snow, then supposed to be the lowest possible reduction of temperature. This, however, seems to be inaccurate: Boerhaave gives a different account of the matter, which is mentioned in the "Philosophical Transactions," vol. xlv. p. 680. The zero was fixed from "the lowest cold observed in *Feland*," (Iceland,) which was supposed to be as low a temperature as was likely to become the object of philosophic investigation: but when artificial methods of reducing the temperature of bodies much lower, and occasional natural colds brought the mercury below that point, a scale of equal parts was extended below the 0°; the ascending series of degrees being distinguished by sign + or *plus*, and the descending series by the sign - or *minus*.

The principle which dictated the peculiar division of the scale is as follows:—When the instrument stood at the greatest cold of Iceland, or 0 degree, it was computed to contain 11,121 equal parts of quicksilver; which, when plunged in melting snow, expanded to 11,156 parts; hence the intermediate space was divided into 32 equal portions, and 32° was taken as the freezing point of water: when the thermometer was plunged in boiling water, the quicksilver was expanded to 11,136 parts; and therefore 212° was marked as the boiling point of that fluid. In practice, Fahrenheit determined the divisions of his scale from two fixed points, the freezing and boiling of water. The theory of the division, if we may so speak, was derived from the lowest cold observed in Iceland, and the expansions of a given portion of mercury.

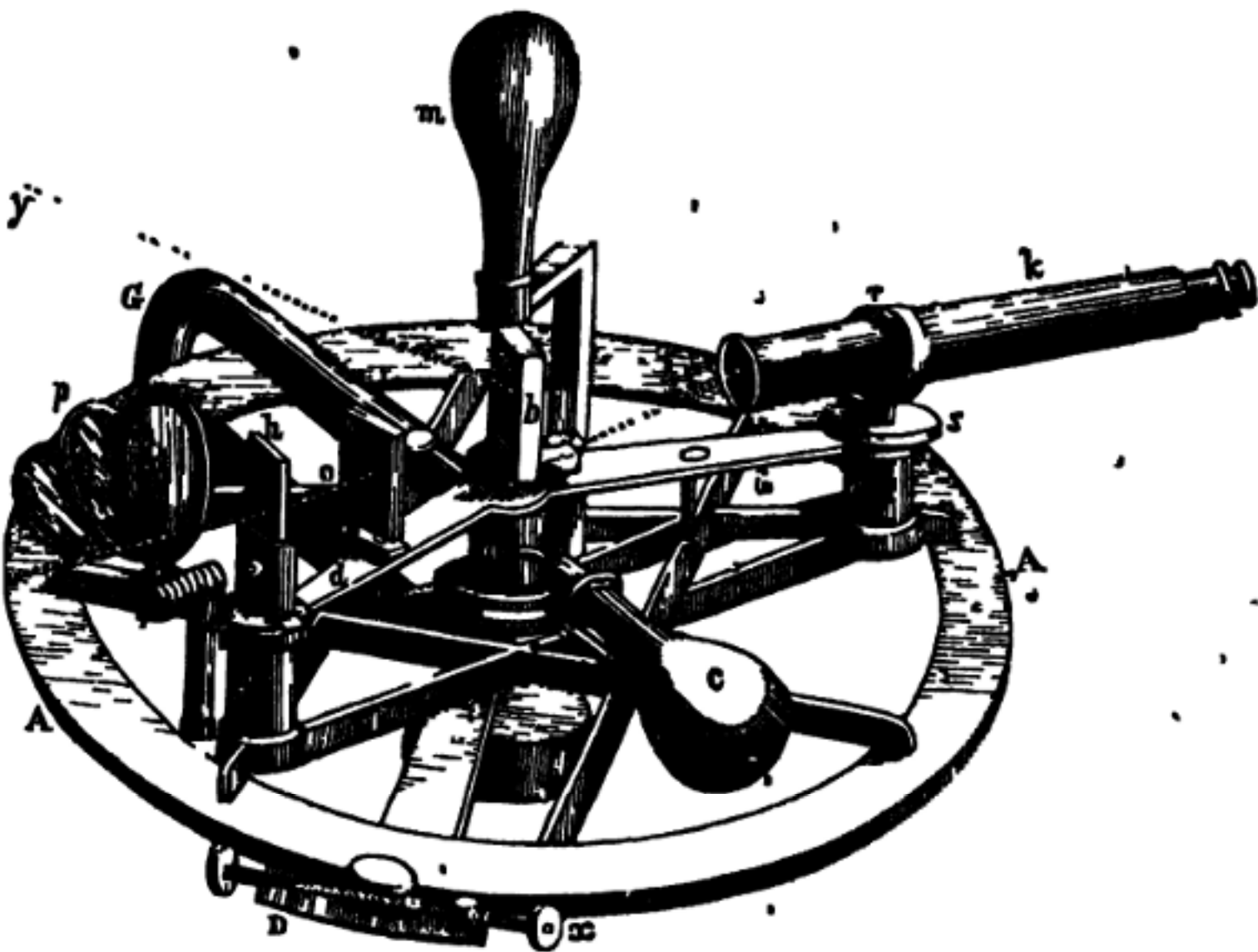
The mercurial thermometer was used by the Italian philosopher, Renaldini, before the end of the seventeenth century; and he proposed, in 1694, an ingenious method of graduating it between the freezing and boiling points of water, by successive mixtures of determinate weights of boiling and ice cold water.

The great advantages of Fahrenheit's thermometer over every other previous invention, consisted in its applicability to a greater range of temperature, from the freezing to the boiling point of quicksilver, in its not soiling the containing tube, and in its receiving the impressions of heat and cold more readily, while its density rendered capillary tubes filled with it perfectly visible; and thus the instrument became more portable and delicate.

Fig. 1.



TROUGHTON'S REFLECTING CIRCLE.



•THE REFLECTING CIRCLE.

THE instrument which bears this appellation is of the nature of Hadley's quadrant, and constructed upon the same principles; we shall therefore consider our readers as acquainted with that well-known instrument. Although there are few purposes in practical astronomy and surveying, to which this kind of instrument may not be advantageously applied, yet it was originally constructed for, and has been chiefly used in making lunar observations for finding the longitude at sea. The late Professor Mayer of Gottingen, the ingenious and laborious astronomer who first furnished tables for that purpose, seems to have judged well of what kind of instrument would ultimately be used, to effect the best practical solution of a lunar problem. Agreeable to this idea we find, that when he transmitted to England his solar and lunar tables, they were accompanied by drawings, and a description of the first reflecting circle, and were published by the Board of Longitude in the year 1770.

Description of Borda's Reflecting Circle.—About the year 1775, the justly-celebrated Chevalier de Borda, turned his thoughts to the improvement of the reflecting circle of Mayer, and, after twelve years application to the subject, gave his labours to the public in an excellent pamphlet, which appeared at Paris in 1787. In this work the Chevalier minutely describes the former construction, gives a particular account of his own improvements, as well as ample instructions for using the instrument, and accompanies these with complete directions for finding the longitude by the lunar method, together with new rules and tables for this and other nautical purposes.

Description of Troughton's Reflecting Circle.—Many of the circles of Borda had been made in London by different artists, chiefly for foreign orders, and for the late Mr. J. H. de Magellan, who made a few trifling alterations in its construction, and who put in an ineffectual claim to the invention of the method of making crossed observation. About the year 1794, that ingenious artist, Mr. Troughton turned his attention to an instrument, which hitherto seemed only to have claimed the attention of foreigners; and by dispensing with the repeating principle in his new construction, he found it would afford him the means of making a much more simple and commodious instrument for his customers, which would be greatly superior in precision, and yet in management not very different from those they had been accustomed to use. The following is a representation of both sides of this circle.

Fig. 1, is a plan of the divided side of the instrument, and fig. 2, a perspective view of its upper side. A A, in both figures is a circle of brass, with a narrow ring of silver let into a circular groove in it, as is seen in fig. 1, on which silver the divisions are made. B B B are three arms, carrying verniers at their ends; they are all cast in one piece, and screwed to a truly-turned steel axis, fitting into a tube, which is screwed to the centre of the circle; (this tube cannot be seen in the plan, but is denoted by A in fig. 2;) the index glass B, which is a plane silvered mirror, is fastened to the other end of this axis by three screws, in such a position, that the centre line of the steel axis it is fixed to, if produced, would exactly coincide with the plane of the silvered surface of the mirror, and consequently that the plane of the mirror produced passes through the centre of the circle A A, perpendicular to its plane.

To the upper end of the tube A, fig. 2, a crooked

plate of brass, D D is fastened, and connects it with two other tubes E and F, whose lower ends are fixed to the cross-bar frame of the circle; one of these F, has the mirror H, called the object glass, placed on it; the other has a telescope K fixed to it, directed to the object-glass H. The instrument is held, when in use, by handles adapted to different occasions, of which there are four; two perpendicular, and two parallel to the plane of the circle; of the letter E, is one on the upper side, supported by a small pillar coming from the interception of two of the bars of the frame, and steadied by entering the tube A; the other handle is at the divided side of the circle, and is fastened to the circle at the upper side, in the same manner as E, by a crooked hollow tube G, going round the circle; of the other two handles, one M is above the circle, screwed into a cock fixed to it, so that it is perpendicular to the centre of the circle, it comes over the index-glass, but does not touch it. The other handle is screwed into the handle of the crooked tube G, so as to be in the same line with the upper handle M; O are three dark glasses, between the index and horizon glasses, turning on a joint, so as to be put out of the way when necessary, or any one or two of them can be turned in the line of the telescope to darken the light, more or less, in observations of the sun; P are three other glasses supported by a small pillar behind the horizon-glass, which can also be turned back as is necessary. The telescope is screwed into a brass ring R, this is supported by a square piece of brass, tapped at the corners, so as to form a screw; and by turning S, a nut upon the screw, the telescope can be raised or lowered parallel to itself; there is also an adjustment to bring the line of collimation of the telescope to be parallel with the plane of the circle.

The circle is divided on the silver ring shown in the plan into 720 parts, each of which answers to a degree, as this instrument measures double the angle shown upon the arc, the same as the Hadley's quadrant; these are subdivided into three, each of which will be twenty minutes. The verniers include fifty-nine of these divisions, and are divided into sixty; the coincidences of these will subdivide each original division of the circle into sixty parts, each equal to twenty seconds. The arm on which the vernier D is fixed, has a clamp at its end to fasten it to the circle; and a fine screw X, to move it slowly a small quantity after it is clamped.

The dark glasses, in sets of three, are fixed to the instrument in such a manner, that any or all of them may be used at the same time, as circumstances may require. This gives the circle before us a decided superiority over all the others. Nor is it a matter of small importance, with respect to convenience, that a handle is found both above and below; by one or other of these, in every possible position of the instrument that observations can require, it may be held right or left, as is found most convenient to the observer. It must, however, be acknowledged, that the reflecting circle, under the best circumstances, is obliged to be held two or three inches farther from the observer than the sextant is, and of course, bears proportionally heavier upon his arm. Mr. Troughton is of opinion, that this inconvenience is the principal, if not the sole cause, that the circle has not yet come into general use; but we would hope, that an inconvenience so trifling, cannot deter a good officer from exercising the best means of obtaining the truth; especially, when we consider how much is entrusted to his

care, and that the safety of the whole depends, in a great degree, upon ascertaining, in a long voyage, a few points of longitude and latitude, upon which, with confidence, he can rely. We shall now describe the manner of making an observation, by this instrument, of the angle between two objects, nearly in the same horizontal plane, we suppose all the adjustments of the instrument to be perfect; the observer first holds the instrument in his right hand, by the handle screwed to the lower handle of the tube G; he looks through the telescope K, and unsilvered part of the horizon glass H, and directs it to one of the objects which will be in the dotted line K G; he then turns the index and index glass B, by its arm D, which must be unclamped, until the other object in the line Y B, is reflected from B to H, and from H, by the silvered part of the glass, into the line K G, in which is placed the observer's eye; he then clamps the arm D, and gently turns the screws X, backwards or forwards, until the reflected image of the object in the line Y, and the other object seen through the telescope, both exactly cover one another. The observation is now half made, and the observer reads off and writes down the degrees, minutes, and seconds, of each vernier; he then inverts the instrument, holding it by the handle M, and directs the telescope to the object, in the line Y B, and brings the reflected image of the object, in the line K G into view, by turning round the index and index glass the same as before; the observation is then read off, and registered. To determine the angle measured, a mean of the products of both observations must be taken; this is the angle between the lines Y B and K G. A small microscope M, in the plan, is used to examine the verniers, and it can be applied to either vernier, as required.

The dark glasses O P are only wanted in observing the sun or moon. It is evident that by inverting the instrument, as we have described, the index error is of no consequence, as it will be always more in one side and less in the other. The advantages of this instrument, when compared with the sextant, are chiefly these; the observations for finding the index error are rendered useless, all knowledge of that being put out of the question, by observing both forwards and backwards. By the same means the errors of the dark glasses are also corrected; for, if they increase the angle one way, they must diminish it the other by the same quantity. This also perfectly corrects the errors of the horizon-glass, and those of the index-glass very nearly. But what is still of more consequence, the error of the centre is perfectly corrected, by reading the three branches of the index; while this property, combined with that of serving both ways, probably reduces the errors of dividing one-sixth part of their simple value. Moreover, angles may be measured as far as 150° , consequently the sun's double altitude may be observed when his distance from the zenith is not less than 15° ; at which altitude, the head of the observer begins to intercept the rays of light incident on the artificial horizon; and of course, if a greater angle could be measured, it would be of no use in this respect.

This instrument, in common with the sextant, requires three adjustments. First, the index-glass perpendicular to the plane of the circle. This being done by the maker, and not liable to alter, has no direct means applied to the purpose; it is known to be right, when, by looking into the index-glass, you see that part of the limb which is reflected in

contact with the opposite side of the limb, as one continued arc of a circle: on the contrary, when the arc appears broken, where the reflected and direct parts of the limb meet, it is a proof that it wants to be reflected. The second is, to make the horizon-glass perpendicular. This is performed by a capstan-screw, at the lower end of the frame of that glass; and is known to be right when, by a sweep with the index, the reflected image of any object will pass exactly over, or cover the image of that object seen directly. The third adjustment is, for making the line of collimation parallel to the plane of the circle. This is performed by two small screws which also fasten the collar into which the telescope screws, to the upright stem on which it is mounted: this is known to be right, when the sun and moon, having a distance of 130 degrees, or more, their limbs are brought in contact just at the outside of that wire which is next to the circle: and then, examining if it be the same, just at the outside of the other wire: its being so is the proof of adjustment.

When lunar tables, &c., of Mayer, as improved by Mason, were used for the construction of the nautical almanac, the sextant, as it came from the hands of our best makers, was, in point of exactness, nearly on a level with its columns: but the tables of Gauss, computed from the theorems of La Place, left both far behind. These now, however, form the basis of our almanac, and an instrument of commensurate exactness is also to be found in the reflecting circle.

With the reflecting circle so constructed, the almanac so improved, and with Captain Mendoza's excellent tables, for finding the longitude, either at sea or land, it is no longer either a doubtful or a difficult operation.

Particular instructions for adjusting and observing with Troughton's Reflecting Circle, are printed and usually given with the instrument.

METEORIC STONES, OR AEROLITES,

ARE solid, semi-metallic substances, which fall from the atmosphere. The descent of such bodies had been long reported; but the fact was not considered authentic till within a few years. The larger stones have been seen as luminous bodies moving with great velocity, descending in oblique directions, and frequently with a loud hissing noise, resembling that of a mortar-shell, when projected from a piece of ordnance. They are sometimes surrounded with a flame, tapering off to a narrow stream at the hinder part, are heard to explode, and seen to fly in pieces. Of course, these appearances have been observed only in the night; when the stones have fallen in the day-time, the meteor has not been observed, but the report and the shower of stones only have been noticed. The same meteoric mass has often been seen over a great extent of country; in some instances, a hundred miles in breadth, and five hundred in length, which implies that they must have had a great elevation. Indeed, from various calculations, it appears that during the time in which they are visible, their perpendicular altitude is generally from twenty to a hundred miles; and their diameter has in some instances been estimated to be, at least, half a mile. Their velocity is astonishing: though rarely visible for more than a minute, yet they are seen to traverse many degrees in the heavens: their rate of motion cannot according to calculation, be

generally less than 300 miles in a minute. From the dimensions of these moving bodies, which certainly have not been overrated, since they have been known to illuminate, at once, a region of one or two hundred miles in extent, we are warranted in the conclusion that the stones which come to us from them, form but a very small portion of their bulk, while the main body holds on its way through the regions of the heavens. The velocity with which the pieces strike the earth is very great, frequently penetrating to a considerable depth, and when taken up they have been found, in some cases, still hot, and bearing evident marks of recent fusion. Such falls have happened in cloudy as well as in clear weather, which leads to the belief that they are wholly unconnected with the state of the atmosphere. The most remarkable circumstance respecting them is, that they invariably resemble each other in certain cognizable characters, both as respects their external properties and chemical composition, so as to render it possible for a mineralogist or a chemist to recognise them with certainty, though he should have no information of their origin or fall. Those specimens in which earthy matter preponderates, resemble pretty closely certain varieties of the trachytic rocks, or ancient lavas, but they invariably contain, disseminated through their substance, an alloy of iron and nickel, which has as yet never been discovered among the productions of our earth. The earthy minerals of which they are composed, are feldspar, olivine and augite—the former greatly preponderating; and of metallic substances, besides the native iron, magnetic iron pyrites is a frequent ingredient. The alloy of iron and nickel often contains chrome, manganese and cobalt in minute proportions. This alloy varies in the proportion which it bears to the earthy matters, in stones which have fallen at different times: sometimes it is scarcely to be detected without the aid of the microscope; at other times it forms more than one half the bulk of the stone, and immense masses are found consisting entirely of native iron: such masses are called *meteoric iron*, while the expression *meteoric stones* is applied more strictly to those in which the earthy minerals preponderate. These last are invariably coated, on the outside, with a thin, black incrustation, and have in general a spherical figure, in which we often observe indentations, similar to those which are presented by a mass that has been impressed with the fingers. These constant characters, as respects their fall, and chemical and mechanical composition, indicate a common origin, and have given rise to a variety of hypotheses to account for their phenomena: we can only hint at these hypotheses. Some attribute them to terrestrial, and others to lunar volcanoes. They have again been supposed to be concretions formed in the regions of our atmosphere; while others have considered them as small planets revolving about the sun or earth, which, coming in contact with our atmosphere, take fire from the resistance and friction which they meet with in passing through it. With regard to the first supposition, viz. that these stones proceed from terrestrial volcanoes, it will be sufficient to observe, that no remarkable eruption has been known to have happened at or near the time of their fall, and that such bodies have been found at the distance of some thousand miles from any known volcano; besides, the immense force that would be necessary to project bodies of such enormous dimensions as these meteors are known

to possess, far exceeds any force that we can conceive of, not to notice the want of similarity between meteoric stones and ordinary volcanic exuviae. As to the theory that they proceed from volcanoes in the moon, it has a greater degree of probability. The same force that would project a body from the moon to the earth, would not, if it were exerted at the earth's surface, send the same body to the distance of ten miles, in consequence of the superior gravity of our planet, and the density of the atmosphere. It is computed that a body projected from a favorable spot on the moon's surface—say the centre of her disk opposite the earth—with a velocity about four times that commonly given to a cannon-ball, or 8,220 feet per second, would carry it beyond the centre of attraction, and consequently into the sphere of the earth's activity; whence it must necessarily either fall to the surface of the earth, or circulate about us as a satellite. A body so projected from the moon to the earth, would take three days in its passage; which is not so long but that it might retain its heat, particularly as it is doubtful whether in passing through a vacuum, or very attenuated medium, it would be possible for the caloric to escape, not to say that it might acquire a fresh accumulation of heat by passing through the denser parts of our atmosphere: besides, eruptions, resembling those of our volcanoes, have been frequently observed in the moon; and her atmosphere is extremely rare, presenting but little resistance to projected bodies. This theory might, perhaps, be tenable if we had only to account for these showers of stones which come to our earth's surface; but these, it has been seen, are a very trifling part of the main masses from which they descend, and which are believed to be, in some instances, more than a mile in circumference. And since it is conceived that we experience a shower of these stones every few months, in some part of the world, it is obvious that at this rate the whole mass of the moon must soon be shot away. Nor is this all. Among a number of bodies, thrown at random from the moon, it is not probable that one in ten thousand would have precisely that direction and that rate of motion which would be requisite to cause it to pass through our atmosphere without falling to the ground. With regard to the theory of these bodies being concretions formed in the air, there is one principal objection, viz., that the velocity with which they strike the earth, estimated by the depth to which they have been known to penetrate, is so great as to indicate their having fallen from heights far exceeding the limits of the terrestrial atmosphere. The remaining theory, especially that modification of it which conceives these meteoric masses to be terrestrial comets, appears encumbered with fewer difficulties than either of the others. The solar comets, it is well known, revolve round the sun in very eccentric orbits. In one part of their revolution, they sometimes come so near as almost to strike his body. They then move off, far beyond the orbits of all the planets, and in some instances are gone hundreds of years before they return. The earth, it is imagined, in like manner, is furnished with its system of comets, whose size and periods of revolution are proportioned to the comparative smallness of the primary body about which they revolve, and which, like the solar comets, fly off in very elliptical orbits, and during the greatest part of their circuit are too far distant to be visible. In their approach to the earth they fall within our atmosphere; by

friction of the air they are heated, and highly electrified, and the electricity is discharged with a very violent report, accompanied with the detachment of a portion of the mass, which descends in fragments to the earth. This hypothesis certainly accounts, in a very happy manner, for most of the phenomena attending the fall of aerolites. The velocity of the meteor corresponds with the motion of a terrestrial comet, passing through the atmosphere in an elliptical orbit. A body moving near the earth with a velocity less than three hundred miles in a minute, must fall to its surface by the power of gravitation. If it move in a direct parallel to the horizon, more than four hundred and thirty miles in a minute, it will fly off in the curve of a hyperbola; and will never return, unless disturbed in its motion by some other body beside the earth. Within these two limits of three hundred miles on the one hand, and of four hundred and thirty on the other (some allowance being made for the resistance of the air and the motion of the earth), the body will revolve with an ellipsis, returning in regular periods. Now, the velocity of the meteors which have been observed has generally been estimated at rather more than three hundred miles in a minute. In some instances it is, perhaps, too great to suffer the body ever to return; but in most cases, it is calculated to be such as would be necessary in describing the lower part of an elliptical orbit.

Various lists of the periods, places and appearances of these showers of stones, have been given from time in the scientific journals. One of the latest and most complete is that published in the *Edinburgh Phil. Journal*, compiled partly from a printed list by Chladni, and partly from a manuscript one by Mr. Allan, read some years ago at the Royal Society of Edinburgh.

CYLINDER ENGRAVING.

To engrave a copper cylinder 3 or 4 inches in diameter, and from 30 to 36 inches long, with the multitude of minute figures which exist in many patterns, would be a very laborious and expensive operation. The happy invention made by Mr. Jacob Perkins, in America, for transferring engravings from one surface to another by means of steel roller dies, was with great judgment applied by Mr. Locket to calico-printing, so long ago as the year 1808, before the first inventor came to Europe with the plan. The pattern is first drawn upon a scale of about 3 inches square, so that this size of figure being repeated a definite number of times, will cover the cylinder. This pattern is next engraved in intaglio upon a roller of softened steel, about 1 inch in diameter, and 3 inches long, so that it will exactly occupy its surface. The engraver aids his eye with a lens, when employed at this delicate work. This roller is hardened by heating it to a cherry-red in an iron case containing pounded bone-ash, and then plunging it into cold water; its surface being protected from oxidizement by a chalky paste. This hardened roller is put into a press of a peculiar construction, where, by a rotatory pressure, it transfers its design to a similar roller in the soft state; and as the former was in intaglio, the latter must be in relief. This second roller being hardened, and placed in an appropriate volutory press, is employed to engrave by indentation upon the full-sized copper cylinder, the whole of its intended pattern. The first roller engraved by hand is called the *die*;

the second, obtained from it by a process like that of a milling tool, is called the *mill*. By this indentation and multiplication system, an engraved cylinder may be had for seven pounds, which engraved by hand would cost fifty or upwards. The restoration of a worn-out cylinder becomes extremely easy in this way; the mill being preserved, need merely be properly rolled over the copper surface again.

At other times, the hard roller *die* is placed in the upper bed of a screw press, not unlike that for coining, while the horizontal bed below is made to move upon strong rollers mounted in a rectangular iron frame. In the middle of that bed a smooth cake or flat disc of very soft iron, about 1 inch thick, and 3 or 4 inches in diameter, is made fast by four horizontal adjusting screws, that work in studs of the bed frame. The *die* being now brought down by a powerful screw, worked by toothed wheel-work, and made to press with force upon the iron cake, the bed is moved backwards and forwards, causing the roller to revolve on its axis by friction, and to impart its design to the cake. This iron disc is now case-hardened by being ignited amidst horn shavings in a box, and then suddenly quenched in water, when it becomes itself a *die* in relief. This disc *die* is fixed in the upper part of a screw press with its engraved face downwards, yet so as to be movable horizontally by traverse screws. Beneath this inverted bed, sustained at its upper surface by friction-rollers, a copper cylinder 30 inches long, or thereby, is mounted horizontally upon a strong iron mandrel, furnished with toothed wheels at one of its ends, to communicate to it a movement upon its axis through any aliquot arcs of the circle. The disc *die* being now brought down to bear upon the copper cylinder, this is turned round through an arc corresponding in length to the length of the *die*; and thus, by the steady downward pressure of the screw, combined with the revolution of the cylinder, the transfer of the engraving is made in intaglio. This is we believe the most convenient process for engraving, by transfer, the copper of a one-cylinder machine. But when 2, 3, or 4 cylinders are to be engraved with the same pattern for a two, three, or four-colored machine, the *die* and the mill roller plan of transfer is adopted. In this case, the hardened roller *die* is mounted in the upper bed of the transfer press, in such a way as to be capable of rotation round its axis, and a similar roller of softened steel is similarly placed in the under bed. The rollers are now made to bear on each other by the action of the upper screw, and while in hard contact, the lower one is caused to revolve, which, carrying round the upper by friction, receives from it the figured impression in relief. When cylinders for a three-colored machine are wanted, three such *mills* are made fac-similes of each other; and the prominent parts of the figure which belong to the other two copper cylinders are filed off in each one respectively. Thus three differently figured *mills* are very readily formed, each adapted to engrave its particular figure upon a distinct copper cylinder.

Some copper cylinders for peculiar styles are not graved by indentation, as just described, but etched by a diamond point, which is moved by mechanism in the most curious variety of configurations, while the cylinder slowly revolves in a horizontal line beneath it. The result is extremely beautiful, but it would require a very elaborate set of drawings to represent the machinery by which Mr. Locket produces it. The copper is covered by a resist varnish

while being heated by the transmission of steam through its axis. After being etched, it is suspended horizontally by the ends, for about five minutes, in an oblong trough charged with dilute nitric acid.

PLANETARY SATELLITES.

SATELLITE, in the solar system, is the attendant of a planet; a body which revolves about the planet, and follows it in its orbit round the sun. Hence the satellite is sometimes called a secondary planet, or merely a *secondary*; the planet about which it revolves being the *primary*.

The planets which are accompanied by satellites are the Earth, Jupiter, Saturn, and Uranus. The Earth has one satellite, namely, the Moon; Jupiter has four; Saturn seven; and Uranus certainly two, if not six.

Satellites of Jupiter.—These bodies were first observed by Galileo, and their discovery followed immediately that of the telescope. With a telescope of ordinary power they may be seen, (unless when eclipsed by the shadow of the planet, or concealed behind its disc) on any clear night, at different distances from the planet, and arranged nearly in a straight line, in which they appear to oscillate backwards and forwards with different velocities, and performing unequal excursions; so that their arrangement with respect to the planet, or *configurations*, are constantly changing. Sometimes they are observed to pass before Jupiter, in which case they cast a shadow on his disc like a small round black spot, whence they are inferred to be opaque bodies illuminated by the sun; at other times they pass behind the planet and are concealed from our view; and all these phenomena occur in regular order, and, with respect to each satellite, after the same intervals of time. An attentive examination of the apparent motions of the satellites soon renders it evident that they revolve round Jupiter in small but unequal orbits, the planes of which are nearly coincident with that of the equator of the planet, which is inclined in a small angle to the ecliptic. Observation also shows that the motions of the satellites about their primary are regulated by the same laws as are observed by the planets in their revolutions round the sun. The orbits are ellipses of small eccentricity, of which Jupiter occupies one of the foci; the areas described by the radius vector are proportional to the times of description; and the squares of the periodic times are respectively proportional to the cubes of the mean distances. Thus Jupiter and his satellites form a system in miniature entirely analogous to that of the sun and planets.

The satellites are distinguished as the *first*, *second*, *third*, and *fourth*, according to their respective distances from Jupiter, the first being that which is nearest the planet. Small as the satellites of Jupiter are in comparison of the primary planet, they are in themselves bodies of considerable magnitude. As compared with the Earth their diameters may be approximately stated as follows:—That of the first rather less than $\frac{1}{4}$, of the second $\frac{1}{2}$, of the third $\frac{1}{3}$, and of the fourth rather more than $\frac{1}{4}$. The third is about the size of Mars. These four moons must present to the inhabitants of Jupiter a spectacle of endless variety. Although their orbits are doubtless elliptical, the eccentricities of the first and second are so small as to be insensible to observation. That of the third is sufficiently sensible; and that of the fourth still greater, but subject to considerable variations. The direction of the motions of the satel-

lites in their orbits is from west to east, according to the general analogy of the planetary system; and from observed periodical defalcations of light to which they are subject, it has been inferred that, like our own moon, each of them revolves about its axis in the same time as that in which it completes a sidereal revolution about the planet.

On account of the shortness of the periods of revolution, the eclipses of the satellites (especially of the first) take place very frequently; and they are phenomena of considerable importance in astronomy, from their affording signals by means of which the differences of terrestrial longitudes are determined, in the same manner as in the case of an eclipse of the moon. The method, however, is not capable of the same precision as is afforded by lunar observations. The eclipses of Jupiter's satellites have also an historical interest, from having led Rømer to the important discovery of the successive propagation and velocity of light. When Jupiter is in opposition with the sun, and his distance from the earth consequently *less* than his distance from the sun by the whole radius of the earth's orbit, the eclipses are observed to happen about 16 m. 26 sec. earlier than they happen when the planet is in conjunction, and its distance from the earth *greater* than its distance from the sun by the same quantity. This phenomenon can only be explained by supposing that light occupies 16 m. 26 sec. in traversing the earth's orbit, and consequently 8 m. 13 sec. in coming from the sun to the earth, which gives a velocity of about 192,000 miles in a second. The theory, with its consequences, has been amply confirmed by Bradley's discovery of the aberration.

Satellites of Saturn.—Saturn, as already mentioned, is accompanied by seven satellites. The most distant, which is by far the largest, was discovered by Huygens in 1665. Four others were first seen by Dominic Cassini about twenty years afterwards; but the two interior ones, which can only be seen under very peculiar circumstances, and with the aid of the most powerful telescopes, were discovered by Sir William Herschel, in 1789. On account of the difficulty of observing the satellites of this planet, their theory has been little studied. The third law of Kepler, which connects the periods and distances, is found to be preserved, as in the system of Jupiter. The planes of their orbits coincide nearly with that of the ring, with the exception of the seventh, which makes an angle with that plane of about 3 or 4°. The orbit of this last is sensibly elliptical, the eccentricity being .49. Owing to the obliquity of the orbits to Saturn's ecliptic, the satellites are not eclipsed in every revolution, but (with the exception of the two interior ones) only fall into the shadow of the planet at the times when the ring is seen from the earth nearly edgewise.

The two interior satellites appear to just skirt the exterior edge of the ring. The seventh, like the satellites of Jupiter, exhibits periodical changes in the intensity of its light, whence it is inferred that it revolves on its axis in the same time in which it completes its orbital revolution.

Satellites of Uranus.—Sir John Herschel remarks, that with the exception of the two interior satellites of Saturn, the attendants of Uranus are the most difficult objects to obtain a sight of, of any in our system. Their existence was first discovered by Sir William Herschel, who suspected the number to be six; but he was only able to obtain micrometrical measures of the distance of two of them, and only those two have yet been seen by any other astronomer.

Sir W. Herschel's observations are given in the *Phil. Trans.* for 1788 and 1797, and again in the vol. for 1815. They were made between the years 1787 and 1798; and from the latter period until 1828 the planet having been unfavorably situated, these satellites remain unobserved, and had even fallen out of notice. Between the latter year and 1834 a series of observations, recorded in the *Memoirs of the R. Astr. Society*, vol. viii., were made by Sir John Herschel for the purpose of verifying his father's results, which, with respect to two satellites, were confirmed in the amplest manner. The periodic times deduced from his observations are respectively 8 d. 16 h. 56 m. 31.3 sec., and 13 d. 11 h. 7 m. 12.6 sec. The orbits are nearly circular, and almost perpendicular to the ecliptic, being inclined to that plane in an angle of $78^{\circ} 58'$; and what is extremely remarkable, as contrary to the otherwise unbroken analogy of the solar system, the motions of the satellites in their orbits are *retrograde*, or from east to west.

SHIP-BUILDING.

THIS is done, in Europe, by representing the form of the proposed ship in three distinct points of view. The first is called the *sheer plan*, and gives a complete view of the side: here are represented the length, depth, rake of the stem and stern; the wales, waterlines, decks, ports, masts, and channels. The *body plan* shows the breadth, having described upon it every timber composing the frame of the ship; those running from the place of greatest breadth forward being described on the right hand; those running aft, on the left. Lastly, there is the *half-breadth*, or *horizontal plan*, showing the whole as if seen from above. To construct these draughts is exceedingly intricate and laborious; and, when finished, they convey no very clear idea of the intended ship. The American builders have a very different mode, very easy and satisfactory. They begin by making a wooden model of the proposed construction, the thing itself in miniature. Here the length, breadth, bulk, all the dimensions, and most minute inflexions of the whole, are seen at a single glance: the eye of the architect considers and reconsiders the adaptation of his model to the proposed object, dwells minutely on every part, and is thus able to correct the faults of his future ship, at the mere expense of a few chips, and while yet in embryo. We shall now state what are the essential qualities of a good ship, and how they are attained. In a ship of war, the great object is speed, connected, as far as may be, with ease of movements, and capacity to accommodate her crew, and carry a large supply of water and provisions. One point, moreover, is especially looked to; this is, that the ship float sufficiently high above water to run no risk of receiving seas in her lower ports in time of action. In order to be secure of this, the constructor must make an estimate of the whole weight of the ship, including body, spars, armament, men, and munitions, and must so model the bottom that it will have displaced an equal weight of water when arrived at the desired depth. But in the merchantman, of which we now particularly speak, the primary consideration is, to attain the greatest capacity to carry cargo combined, as far as possible, with safe and easy movements and rapid sailing. Now, the only way to combine these qualities with any success, is to imitate a form which has stood successfully the test

of experience. This the builder does when he forms his model, guided by a tasteful and accurate eye, accustomed to notice the forms of vessels, and to mark particularly those which have been distinguished for their good qualities.

Among the admitted and well established principles of construction, is the leading one, that the greatest breadth must always be before the centre, and consequently the bow be more blunt than the stern. Some of our best builders place this point only one-third of the length from the stem. Abstractedly, it would seem most important that the bow should be adapted to divide the water with the least possible resistance; but experience has proved that it is far more essential to facilitate the escape of the displaced water along the side of the vessel; for when once a passage is opened for the ship, the fluid tends to reunite abaft the point of greatest breadth, where, instead of offering resistance, it presses the ship forward, in its endeavour to recover its level and fill the vacuum constantly opening behind her. Without recurring to Sir Isaac Newton for the demonstration by which he has shown the mathematical truth of this principle, it may be sufficient to instance the fact, familiar to every seaman, that a log tows infinitely easiest by its biggest end; nor do we find a trifling concurrent testimony in the forms of the finny tribe, which an unerring nature has adapted to divide the element they move in, by a shape gradually diminishing from head to tail. As it is then, less essential that a ship should be sharp forward than aft, there is a further advantage in having the bow full towards the edge, that it may check her in descending into the waves, not abruptly, but gently; pitching being the most dangerous to the hull and spars of all a vessel's movements. Though sharpness towards the sternpost is vitally essential to fast sailing, yet care must be taken to leave the buttock full towards the surface, in order to check the stern gently in descending, and, when scudding before a gale, to lift in timely season, on the arrival of a sea. To hit the exact mean in this respect, so as not to retard the sailing on the one hand, nor on the other to endanger the safety of the ship, requires all the skill of the architect. The midship floor should be nearly flat, in order to render the ship buoyant and stable, or capable of bearing sail. It has been suggested that since stability is in proportion to the length, an elongation of ships might be productive of increased speed; but though they would thus be enabled to carry more sail without an essential increase of resistance, yet it may well be questioned whether this advantage would not be more than counterbalanced by the corresponding increase of difficulty in tacking, manœuvring, and rising to escape the breakings of the sea. There must also be a loss of compactness and strength proportionate to the increase of length, so that such vessels may be only adapted to the smoothness of a lake, or to the purposes of privateers and smugglers, who are desirous to procure rapid movements at whatever sacrifice. An increase of breadth may produce equal advantage, without any sacrifice; for inasmuch as stability increases as the cubes of the breadth, by adding one quarter to the breadth you gain a double stability, and by consequence, a capacity to bear twice as much sail, with but one fourth of increase in the resistance. If it be remembered that the pressure of the water increases in descending from the surface, and that from this cause and the augmented difficulty of displacing

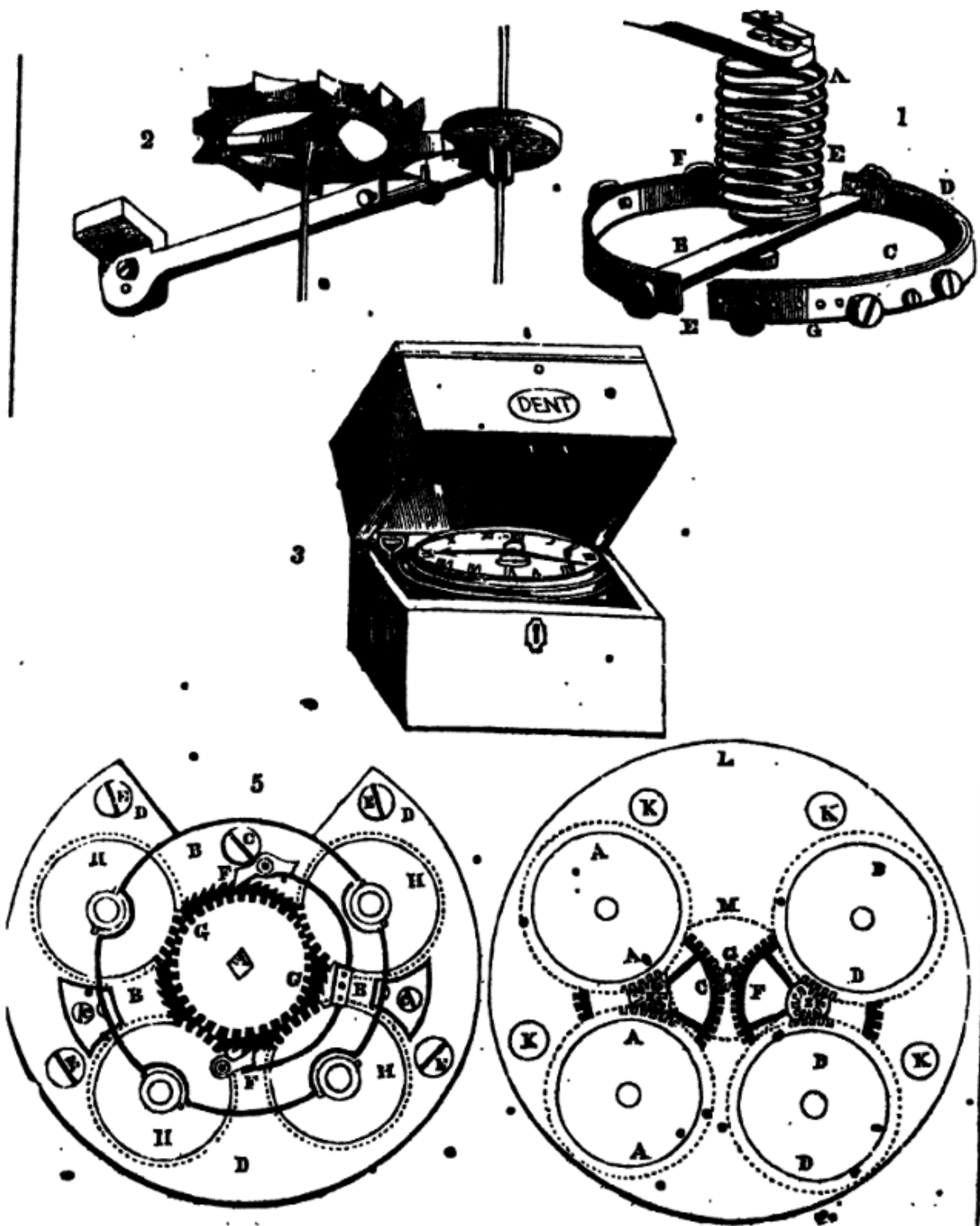
it, the resistance offered to a ship in advancing, is three times as great at the lower as at the upper half of the immersed section, there can be no doubt that, if the law for measuring tonnage left his dimensions optional to the builder, the excess of depth now used would be transferred to the breadth. This being the case, it is deplorable that our government should so long have retained the old rule for the measurement of tonnage. This takes only into consideration the length and breadth at a single point, and, consequently, furnishes no standard whatever to judge of the capacity; hence, the merchant may have his ship made as deep as he pleases, and carry her breadth down to the floor itself, without any increase of tonnage; and one of three hundred tons may be thus made to carry three times as much as another of equal measurement, formed for speed and beauty. Now, as the ship's port charges are determined by her registered tonnage, this is a direct bounty for building ugly and disproportioned ships, and an equally direct tax upon every digression from the model of a bread-tray. Great detriment to the appearance, speed, and safety of our freighting ships results from this absurdity. But to return to our subject; an extreme in breadth, as in length or depth, is also dangerous. All extremes are here to be equally avoided. In civil architecture, an extravagance may be an eye-sore to men of taste, and render the projector ridiculous; but in naval, it too often proves fatal to human life.

Keeping, then, all these principles in view, as far as the tonnage law and the interests of the merchant permit, the builder proceeds to form the half model of his proposed ship, making it of the usual relative dimensions (a quarter of an inch to the foot.) When satisfied with his performance, he takes asunder the horizontal sections of plank of which the block was originally formed, and he has before him all the waterlines in miniature. Having marked these on the floor of the moulding loft, he has all the necessary data, and proceeds to draught the entire frame. This done, pine moulds are formed of all the different parts, and the preparatory labors are complete. The scene now changes from the moulding loft to the ship yard, and the builder turns his attention to the materials. The timber most in request is oak, pine, chestnut, locust, cedar, elm, beech, &c. The felling and choice of timber is in itself an art. The tree should be taken in the second era of its growth, when it has attained maturity, without approaching the period of decay. It should be killed, by removing a ring of bark, at the beginning of winter, when the sap is down, and left to dry and harden before it be cut down. When felled, the timber should be carefully stored in some dry airy place, not much exposed to wind and sun. Painting should not be used, as, by sealing up the moisture in the wood, it rather facilitates than prevents decay. In collecting ship timber, the greatest difficulty is found in procuring the crooked sticks, of which so many are required. In countries where timber has become an object of careful cultivation, this difficulty is anticipated by bending and confining the young trees to the desired form, or by cutting their young shoots at different periods, it having been observed that pollard trees are thus naturally produced by the browsing of cattle.

(To be continued.)

ARRANGING BIRDS IN CABINETS.

It was formerly the custom among our collectors to have each species in a wooden case by itself, with a glass in front; the whole rendered air-tight: in this manner all the birds in the Leverian Museum were arranged, the cases being piled up so as to cover the sides of the apartments. The inconveniences of this mode are obvious, for the specimens could only be examined through the glass; and by having only one species in each case, a great deal of space was sacrificed. To this succeeded the fashion of grouping the birds upon branches, fastened into large cases, on the back and sides of which were painted landscapes, &c.: this was introduced, we believe, by Bullock, whose whole collection was displayed in this manner. This plan is certainly better adapted than the first for producing effect, by the contrast of colors and the variation of attitude; so that, for those persons who merely possess a few splendid specimens for show, this is, perhaps, the best way of displaying them to advantage. For all useful or scientific purposes, however, it is much worse than the last: the fact cannot be accurately seen, from the comparative obscurity in which very many of the birds must be thrown; and, as only the glass front of the case can be removed, all attempts either to accurately examine, or measure, or draw, or describe specimens thus disposed, will not only be imperfect, but in many instances impossible. This barbaric taste, however, is now exploded, at least in all collections intended to be really useful and instructive. The admirable plan upon which the noble collection of birds in the Garden of Plants at Paris is arranged, has been adopted both at the British Museum, the Zoological Society, and the Liverpool Institution. Each specimen is mounted on a wooden stand, and then arranged on narrow shelves in ordinary glass cases, the whole interior of which is painted of a rose-colored white, for the purpose of bringing out the birds in relief. These stands are made, of course, of different sizes and heights, to suit the different sized birds. The best we have seen are turned in France; and if a large quantity are wanted, it might be as well to procure them, if possible, from Paris, as the custom-house duty is not high. A more simple, and equally efficacious, plan, is to mount the bird upon a proper sized natural twig, and then insert the end into a slab or block of wood, sufficiently heavy to stand firm. For woodpeckers, a roundish block should be preferred, as more suited to the natural attitudes of these birds; and for such as walk only upon the ground, the stands should be made of slabs of wood of different sizes, and about an inch thick, neatly whitened: on a label in front may be printed the generic and specific name, the English name, and the country inhabited by the bird: the specimen is then fit to be placed in the case. The shelves should be as narrow as possible, in order to admit of as many rows of birds as the case will conveniently hold, and also to prevent the more backward ranges from being enveloped in shade: they should not be fixed as ordinary shelves, but moveable, like those in the generality of bookcases, so that their positions may be changed, and they may be raised higher or lower, as circumstances require. The glass front should be easily taken off; or it may be hung on hinges, the sides being lined with felt or baize, so that as little air or dust can enter as possible.



DENT ON THE CONSTRUCTION AND MANAGEMENT OF
CHRONOMETERS, WATCHES AND CLOCKS.

DENT ON THE CONSTRUCTION AND MANAGEMENT OF CHRONOMETERS, WATCHES AND CLOCKS.

A LITTLE pamphlet has lately been published by Mr. Dent, the well known chronometer-maker in the Strand, and presented by him gratis to purchasers, and sold at 1s. to strangers, on the above important subject. The action of all the various kinds of watches is plainly and sufficiently described, and illustrated by excellent wood-cuts. The comparative excellencies of the duplex, lever, horizontal and vertical escapement are also pointed out with fairness and truth; and those who are about to purchase an instrument of this kind, and particularly he who desires a chronometer, will do well to procure the pamphlet, whether he may prefer Mr. Dent as a maker or not. The work, small as it is, is also judiciously interspersed with some very appropriate remarks on the watch-trade in general. It would lead us too far, at the present time, to quote any of the remarks on the latter subject; but not having hitherto treated of the construction of the chronometer, we prefer, in giving an example of the style of the book, to extract Mr. Dent's remarks on his own chronometer, the excellence of which may be inferred from the circumstance that it has obtained the *first* premium from the Government—but let Mr. Dent speak for himself:—

“Next in degree of perfection comes the chronometer, which is little inferior to the astronomical clock. The former, it may be remarked, is a fixture; while the chronometer is portable (as seen by drawing, No. 3) from its having, instead of a pendulum, an elastic ‘balance-spring’ for its governing power. The wood-cut, No. 1, shows all that may be considered the governing power, or that part which constitutes the principal difference between this and other time-keepers.

“A, is the balance-spring, the elastic force of which, when wound up by the motive power, through the escapement, into a state of tension, gives motion to the balance B. The elastic force of this balance-spring A varies by change of temperature, for 68° of Fahrenheit, upwards of six minutes in twenty-four hours; and this irregularity is corrected by the balance B varying its diameter, in the same manner as the balls of a steam-engine govern that ponderous machine; with this exception, that while the balls of a steam-engine are governed by gravity and centrifugal force, a similar effect is here mechanically produced from the different metals (brass and steel) expanding and contracting differently under a change of temperature, thus varying the diameter or momentum of the balance in accordance therewith.

“Heat renders the balance-spring A weaker; the momentum of the compensation-balance B is decreased, making a gain equal to the loss occasioned by the relaxation of the spring, the effect of temperature on the strength of which may, perhaps, be successfully illustrated by a familiar comparison. A piece of sealing-wax, we know, loses its elastic strength by heat; in summer it will hardly support its own weight, while in winter it is solid and strong. Precisely the same effect is produced on metals. The only difference is in the degree of temperature required to act on the two substances. There is an intensity of heat in which steel will become as fluid as melted wax, and there is a degree of temperature at which the elasticity of both steel and wax is more perfect than at any other. The efforts

produced by an increase of heat on metal and wax (or resinous substances) are principally of two kinds: one is to elongate and extend the substance; the other is to decrease its elastic force. By an experiment which I instituted and published at the meeting of the British Association at Cambridge, in 1833, I showed that 306 seconds are due to the loss of elasticity, and 79 only to elongation and extension of the balance-spring in twenty-four hours, on an increase of temperature, from 32° to 100° of Fahrenheit's scale. Therefore, a watch having no compensation for variable temperature would deviate upwards of six minutes, as before stated.

“We will now describe the compensation-balance, by which the error is compensated. The compensation, as already observed, is produced in the variation in the diameter of the compensation-balance B, and by the following means: the internal part of the rim, C, is of steel, while the external part, D, is of brass, and they are united together by heat—or, in other words, the brass is run, by means of heat, on to the steel. The expansion of these metals upon application of the same degree of heat varies; the brass expands *more* than the steel, and as it cannot release itself from this, so neither has it the power of expanding itself in length, being restrained by the steel; consequently a curve is made by the brass forcing the steel into that figure, and the momentum or power of the compensation-balance varies, and compensates for the loss or gain in the balance-spring, occasioned by a change of temperature. The rim of the balance is cut open at E, making two segments, allowing the brass D, on the external rim, to force into a curve the steel of the inner part of the rim C; the screws F act as weights to compensate, and the holes on the rim of the balance admit of these screws being variously adjusted, so as to allow the curve to take them nearer to or further from the centre. *Example*—If the screw F, which is nearest the end of the segment at E, were moved backwards into the hole G, the distance occasioned by the curve would be diminished, and the weight of F would not, by an increase of heat, go in so far towards the centre as if it remained in its present hole; and the result would be, that in the hole G a less power of compensation for the loss of the balance-spring by an increase of heat, would be effected. The description of compensation is precisely the same in all watches to which a compensation-balance is applied; viz. to those of the duplex and lever kind. The escapement used in the chronometer, as seen in drawing No. 2, is termed a detached one, which means that the vibrations performed by the balance are nearly detached from the pressure of the motive power, during the greatest part of its arc of vibration. Its great advantage is, that it requires no oil. This escapement is of French invention, improved by the English.

“A further extension of performance, without the necessity of winding, being a great desideratum in the use of the chronometer, I have been induced to take out letters-patent for an instrument that will go from eight to thirty-two days. The principle on which this end is effected is the use of three or more mainsprings, instead of applying the power by means of one thick one. Another advantage of my improvement is, that instead of the great pressure which, in the ordinary chronometer, is laid upon the teeth of one wheel, the power is here subdivided between three or four; whence, not only the pressure above alluded to is avoided,

but a mean force is conveyed through several wheels and pinions. The thinness of these mainsprings is a security against breakage; and even on the supposition that *one should break*, the service of the chronometer is not lost, as it will perform notwithstanding the absence of one.

"*Figure 4.*—Example of a plan of the wheel-work, by which the force of four mainsprings is made to act simultaneously upon the train of a chronometer: A, two wheels affixed on two of the mainspring barrels, and driving a pinion, B, at nearly opposite sides; B, a pinion driven by the two barrel-wheels A, having on its arbor (or axis) an intermediate wheel, C; C, an intermediate wheel on the arbor of the pinion B, and acting in the centre pinion G; D, two wheels similar to those at A, affixed to two other mainspring barrels, and driving a pinion, E, at nearly opposite sides; E, a pinion driven by the two barrel-wheels D, having on its arbor a wheel F; F, a wheel on the arbor of the pinion E, and acting in the centre pinion G, nearly opposite to the action of the wheel C; G, the centre pinion driven at nearly opposite sides by the two intermediate wheels C and F,—this pinion making one revolution in each hour, carries on its arbor the ordinary wheel, which gives motion to the train in the usual manner; K, four pillars; L, the pillar-plate; M, space left between barrels for the train and escapement to be placed.

"*Figure 5.*—Example of a plan of the apparatus for winding up four barrels upon one application of the key: A, the square of the winding-up arbor, upon which the key is applied; B, a plate, or bridge, screwed down upon the upper plate of the chronometer, for supporting the upper pivot of the winding-up arbor A; C, three screws, by which the plate B is secured to the upper plate; D, the upper plate, in which is supported the under pivot of the winding-up arbor, through which plate also the arbors of the four barrels pass; E, four screws, for securing the upper plate down upon the pillars of the pillar-plate of the chronometer; F, a ratchet wheel, click and springs, shown by dotted lines, for holding the winding-up arbor against the force of the mainsprings; G, a wheel fixed on the winding-up arbor A, and which actuates, during the winding, four wheels fixed on the four barrel arbors; H, the four wheels fixed on the four barrel arbors, and driven by the wheel G.

"It is obvious that, from this construction, the turning of the winding-up arbor A, by the application of the key upon its square, will at the same time turn all the four barrel arbors, and therefore will wind up all the four springs simultaneously.

"My patent extends to the coating of the balance-spring and compensation-balance, with pure gold, by the electro-metallurgic process. This effectually protects them from the rust produced by moisture and impregnated atmospheres—a damage which they are frequently subjected to on ship-board. The importance of the chronometer for navigation has been such, that the governments of most countries have, by proclamation, offered public rewards for its improvement; and so great has been the success attendant on these inducements, that the chronometer may now be considered as an instrument of comparatively general manufacture. It is no longer dependent upon government patronage: the universal conviction of its importance and utility has so increased the demand, as to secure rigorous competition on the part of the artist, and render it an article of commerce."

SHIP BUILDING.

(Resumed from page 216.)

THE timber being collected, the workmen, with each his model, proceed to fashion the pieces of wood assigned them, a due regard being had to careful conversion, that no stick is hewn contrary to its grain, so as to impair its strength, nor a larger one ever used than is necessary for the particular purpose; and, especially, that no bad or even indifferent wood be put in an important place, whence it could be removed only with difficulty.

The frame being now ready, we proceed to put it together. And first, the blocks are placed in the ship, and the keel laid upon them, the pieces being snugly scarfed together, and bolted; the keel is also scarfed to the stem forward, and the sternpost aft, the apron being raised with the stem, and the transoms and fashion pieces with the stern, if the vessel be not large. In laying down the keel, great care must be taken to preserve its perpendicularity, for which purpose it is pinned with treenails on either side of the blocks; also in raising and propping the stem and stern, and every piece of the frame. It is only by extreme attention that the builder avoids producing a crooked ship—an artificial monster of by no means rare occurrence. The floor timbers are now let into the keel, and every other one is there firmly bolted and riveted; they are crutches of trees formed by the trunk and one of the branches. Hence, in order to have equal strength on both sides, the butts should be placed alternately to right and left. As the floor timbers are the great connecting principles of the ship, to which they bear the same relation as the ribs to the body, too much care cannot be taken in selecting and securing them. The dead wood which fills up the angles at the stem and stern being got in, the kelson is laid upon the floor timbers, which let into it, until it rests upon the keel; its pieces are scarfed together, and to the stemson and sternson, which forms its prolongation up the stem and stern. A bend usually consists, besides the floor timbers, of four futtocks, and one top timber, on each side; the first, or lower futtock, descends to the keel, beside the floor timbers, to which it is either bolted or pinned with treenails; the heel of the second rests upon the head of the floor, and bolts to the side of the first; and so on up to the top timber. Towards the stem and stern, the timbers do not meet the keel at right angles, but are inclined respectively forward and aft, as well to economize timber, by adapting the sticks to the inclination of the curves, as to augment the strength of parts much exposed to shocks from waves, rocks, and icebergs. The different portions of the frame are thus raised to their places by sheers and tackles, and then carefully stowed and kept to the proper breadth by cross-pales; ribbands are also carried round the frame and bolted, and every precaution taken to confine each separate part to its particular position. The frame, being now complete, is dubbed smoothly off within and out, preparatory to plank-ing. Sometimes the frame is made completely solid, and calked; in this case, the interior covering of plank is dispensed with, excepting a few strengthening streaks. This method has many advantages; a little additional width to the timbers brings them in contact, when, besides their being naked, and exposed to the air within, there is no space for the generation of those destructive gases which cause dry rot. In this case, salting, which makes a ship damp and unwholesome, is also avoided.

Having advanced thus far in the construction, the next care is to proceed with the planking, which does not merely serve to exclude the water, but to protect, connect, and bind harmoniously together, and is quite as essential as the skin to the body. Though apparently the most simple part of this wonderful machine, it is yet very difficult. Just as, in draughting the frame, it is necessary to have in view all the ports and scuppers to be carried clear of the timbers, it is essential, in planking, to have a preconceived plan of the whole. The butts must not come near the scarfs of the keel, nor beside each other within or without, nor near the port-holes, nor opposite the pumps, lest the oakum be sucked out, but must be judiciously distributed, so as to impart equal strength to every portion. It is also one of the nicest arts of the builder, so to carry up his planking as with little waste to keep his seams always fair with the waterlines. When it is necessary to bend a plank at the bow or stern, it is heated by steam, and then forced into place with screws and levers. While this is going on, the beams are erected and pillared on the inside planking; the knees, which are crotches of timber or iron, confine them to the sides, also the transoms at the angles of the stern; in like manner the breast-hooks hold the stem to the planking and cant timbers of the bow. All this being attended to—the decks, plank sheer and rails finished, pumps placed, the bits for securing the cable, the capstan for raising the anchor, or, instead of these, the windlass, which, in merchantmen, more commonly serves the double purpose, the catheads for suspending the anchors, hatchways, mast holes, and a variety of other objects, which, though too many to enumerate, must by no means be forgotten—all being complete, the carpenter makes room for the calker, who carefully stops all the seams with oakum, and smears them with pitch. The scraper follows the calker, and, water having been pumped into the hold, to ascertain whether there is any leak, the bottom is ready to be sheathed or coppered, to protect it from the worms. Sheathing with wood is practised with iron-fastened ships, because copper would cause the bolt heads to corrode, if placed against them. It consists simply in covering the bottom with pine boards, sheets of paper soaked in hot pitch being placed between. In sheathing with copper, paper is also interposed. The plates overlap each other from bow to stern, to prevent their being stripped off by the continual shock of the passing water.

Our ship is now ready to be launched. This is the triumph of the builder. It is a nice operation, and is thus performed. If there be no ways in the slip (which is always an inclined plane descending into the water), they are immediately prepared. Two parallel platforms of solid timber are laid, one on each side of the keel, at the distance of a few feet from it, and extending from the stem as far below the stern as can be reached at low water. In this position they are carefully and firmly blocked, and supported throughout their length. This double platform is called the *ways*. Upon it a second system of timber is loosely laid, and well greased between. The space from these last to the ship's bottom is every where filled with wedges of soft wood fashioned to its curves. The whole is called the *cradle*. The extremities of the cradle at the bow and stern are bound tightly across the keel with chains or ropes, and it is further kept from spreading by stout mouldings, which overlap the outer edges of the ways. When the rising tide has

reached well up the ways, the wedges are simultaneously driven on every side, and the ship is raised from the blocks on which she has hitherto rested, and made to repose entirely on the cradle. The shores are all removed except the two spurs planted against the counters, and when the proper moment has arrived, these are also knocked away. The vessel, now abandoned to her weight, and encouraged by the yielding of the grease, begins slowly falling along the inclined plane; her motion becomes at each moment more and more rapid; the ways smoke and ignite with the pressure and velocity of the moving mass; and, in a twinkling, the noble fabric has abandoned for ever its union with the land, and entered, careering and joyous, upon its destined element.

The moment the ship leaves the land, the builders cease to be competent to her control, and she passes at once to the hands of the seamen. Before launching, the sailors stationed on deck hasten to attach a small cable to some object on shore, and have it clear on deck for veering out; a small anchor, with a second cable, is also prepared to drop on the bottom. By means of this apparatus, when the velocity gained in descending the ways has declined, the ship is gradually checked, and at length drawn alongside of the wharf, which is to be the scene of her equipment. And now, while she is yet light and high out of water, is the most favorable time for shipping the rudder. The rudder is a machine placed at the stern of the ship, by means of which she is steered and turned about at pleasure; for by inclining it to one side, the passage of the water is there strongly opposed, which, checking the advance of that side, gives the other a rotatory motion around it. It consists of two or more pieces of timber, of the thickness of the sternpost, of which, when not inclined, it seems a continuation. Narrow at the water's edge, where it might be endangered by the shock of a sea, and with it the very existence of the ship, it gradually increases in width towards the keel, where, from the nearly straight line in which the water reaches it, it exerts a more direct power to turn the ship. From forty to forty-five degrees is the most favorable angle for it to make with the keel, a greater serving rather to retard velocity than to cause rotation. To ship the rudder, it is only necessary to attach weights of iron to the heel, so that they may be loosed afterwards, and then sink it behind the sternpost, guiding it with ropes to the rudder port, through which it is hoisted by means of sheers and tackle placed above. The pintals having caught the hinges or gudgeons on the sternpost, it is abandoned to their support, while a chock, placed above the upper pintal, prevents it from being unhung. A tiller, with ropes and a wheel, to turn the rudder, completes the steering apparatus. Before raising the masts, it will now be well to take in ballast, especially if the ship be sharp. In every merchant vessel, it is a good rule never to be without a small quantity of copper dross or shingle. And next, the sheers are got ready. They are two stout spars, having the large ends at the sides of the ship, the small ones being lashed firmly together, and overhanging the middle of the deck. They are lashed and rigged with guys and gantlings before being raised; the ends rest on the taffarel, and the tackle to be used in hoisting in the mast, being taken forward to the windlass, serves to raise them. If it be necessary, a small pair of sheers are used to lift the ends until the angle be sufficiently open to give power to the purchase. When erect, they are first

placed over the hole for the mizen-mast, and, if the ship be large, the deck should be shored up, to relieve it of the weight of the sheers and mast. Overhauling your tackle down to where the mast is on the wharf, or in the water, you lash the lower block securely to the front of the mast, just above the centre of gravity. With this, and a smaller tackle or gantling to the mast-head, the mast is taken up abaft the sheers, until high enough, then lowered to its place, the step being tarred, and a piece of money thrown in for luck. The sheers are easily moved forward by their guys and tackles, the shoes in which their heels rest being greased, to slip over the deck. In this way the main and fore-masts are likewise taken in, and, the sheers being drooped over the bows, lastly, the bow-sprit.

(To be continued.)

THEORY OF THE FLIGHT OF ROCKETS.

A **ROCKET**, being properly constructed, with its rod and other appendages attached, fixed in a vertical position, and fire being applied to its mouth, it will (as experience proves) ascend in the air with a prodigious velocity; but upon inquiry into the cause of this ascent, we meet with difficulties little contemplated when we were viewing the beautiful path it described in the medium of its flight. That this ascent is dependent on the medium (or air) in which it is generated, admits not of a doubt; but to describe how, or in what manner it is effected, has engaged the attention of some of the most eminent philosophers. In consequence several theories have been advanced for the explication of the phenomena, and among them those of Mariotte and Desaguliers have claimed the most particular attention.

Mariotte attributes the rise of rockets to the resistance, or reaction of the air against the gas, which is generated by the combustion of the composition. This hypothesis seems to explain the phenomena; but great objections have been brought against it, on account of the difficulty which attends the reduction of it to mathematical investigations:—this difficulty arises from the law which the propelling force must necessarily observe; that is, it will decrease as the velocity increases, in consequence of the partial vacuum left behind the rocket in its flight; so that the velocity becomes as it were both a *datum* and *quæritum*; and the correct solution of the problem necessarily involves the integration of partial differences of the highest order.

The hypothesis of Desaguliers is somewhat different to the foregoing; it is much more familiar with mathematical investigations; as it reduces the whole theory to the most simple form; and we think it is not far from being consonant with the known principles of the phenomena; notwithstanding the argument brought against it by Dr. Rees, and his Editors; and which we shall endeavour to prove by citing higher authority than our own. Desaguliers illustrates his hypothesis in the following manner:—Conceive the rocket to have no vent at the choak, and to be set on fire in the conical bore; the consequence would be, either that the rocket would burst in the weakest place, or that, if all parts were equally strong, and able to sustain the impulse of the flame, the rocket would burn out immovable. Now, as the force of the flame is equable, suppose its action downwards, or that upwards, sufficient to lift forty pounds; as these forces are equal, but their directions contrary, they will destroy each other's action.

Imagine then the rocket opened at the choak; by this mean the action of the flame downwards is taken away, and there remains a force equal to forty pounds acting upwards, to carry up the rocket, and the stick or rod it is tied to. Accordingly we find that if the composition of the rocket be very weak, so as not to give an impulse greater than the weight of the rocket and stick, it does not rise at all; or if the composition be slow, so that a small part of it only kindles at first, the rocket will not rise.

To this we shall add the late Doctor Hutton's philosophy on the ascent of rockets; who says, that at the moment when the powder begins to inflame, its expansion produces a torrent of elastic fluid, which acts in every direction; that is, against the air which escapes from the cartridge, and against the upper part of the rocket; but the resistance of the air is more considerable than the weight of the rocket, on account of the extreme rapidity with which the elastic fluid issues through the neck of the rocket to throw itself downwards, and therefore the rocket ascends by the excess of one of these forces over the other. This, however, would not be the case, unless the rocket was pierced to a certain depth. A sufficient quantity of elastic fluid would not be produced; for the composition would inflame only in circular coats, of a diameter equal to that of the rocket; and experience shows that this is not sufficient. Recourse then is had to the very ingenious idea of piercing the rocket in a conical hole, which makes the composition burn in conical strata, which have much greater surface, and produce a much greater quantity of inflamed matter and fluid. This expedient was certainly not the work of a moment.

The stick serves to keep it perpendicular; for if the rocket should begin to tumble, moving round a point in the choak, as being the common centre of gravity of rocket and stick, there would be so much friction against the air by the stick, between the centre and the point, and the point would beat against the air with so much velocity, that the reaction of the medium would restore it to its perpendicularity. When the composition is burnt out, and the impulse upwards has ceased, the common centre of gravity is brought lower towards the middle of the stick; by which means the velocity of the point of the stick is decreased, and that at the point of the rocket is increased; so that the whole will fall down, with the rocket end foremost.

During the time the rocket burns, the common centre of gravity is shifting and getting downwards, and still faster and lower as the stick is lighter; so that it sometimes begins to tumble before it is quite burnt out; but when the stick is too heavy, the common centre of gravity will not get so low, but that of the rocket will rise straight, though not so fast.

From the experiments of Mr. Robins, and other gentlemen, it was found that the rockets of two, three, or four inches diameter, rise the highest; and they are found to rise to all heights in the air, from 400 to 1,254 yards, which is about three-quarters of a mile. For further particulars respecting the theory of the flight of rockets our readers are referred to Robins's "Tracts," vol. 2. "Philosophical Transactions," vol. 46, page 578; and more particularly to Mr. W. Moor's "Treatise on the Motion of Rockets," in which they will find the subject elegantly treated.

PRESERVING THE VITALITY OF THE EGGS OF BIRDS.

THE preservation of life in the eggs of birds, both before and after they have been sat upon, is often a matter of some importance to sportsmen; to the naturalist it is equally so; for when he has met with a nest in his rambles that appears rare, by abstracting the eggs and placing them under another bird in lieu of the rightful owner, it often happens that the foster parent will adopt and rear them. Or again, when, in what may be called his ornithological rambles, he shoots one or both individuals of a pair which are unknown to him and probably are really exotic, under such circumstances it is common to look closely for a nest built by them, which having taken he may attempt hatching by similar fosterage. Our more immediate attention is, however, directed to the sporting purposes to which preserving vitality in eggs may be applied. Partridges' nests are very frequently disturbed by mowers. Pheasants also are cut out in plantations; and in many other instances it may be desirable to rear young birds from eggs accidentally discovered. We need not inform the reader that a temperature equal to that yielded by the parent bird, if it be duly and regularly maintained, is sufficient for this purpose. We will not enter upon the various methods of maintaining artificial heat further than to observe, that ingenious persons may turn all of them to account when a foster mother cannot be got. Our immediate purpose is to inquire how we may retain so much heat in the eggs, as will be sufficient to keep up their vitality until the hatching process is again brought into full action? We have ourselves, in our boyish days, carried home nests and eggs in our bosom and in our hat, and have thus kept up, without trouble, sufficient warmth for the purpose; but, boylike, the difficulty which always met us on the threshold, which was that of supplying a foster-parent—either deterred us from numerous attempts, or rendered such attempts abortive by mismanagement.

Foster parentage may, however, be gained from some birds, particularly such as build near us and court our acquaintance apparently by their familiarity. Some of these will admit of many liberties being taken with their nests, and will even hatch the eggs, and bring up the young, of other birds. But our principal dependence is on the gallinaceous tribes, which we have made almost artificial animals by directing their habits into new channels. The common hen we can usually depend on to undertake the office of incubation, and also the rearing of the young afterwards; the guinea-fowl now and then only; the domestic pheasant seldom. Pigeons will also, in many cases, hatch the eggs and rear the young of other birds.

It is to the transporting of the eggs which have already been sat upon, we must now draw our attention. In a sunny day a nest of eggs well surrounded with flannel, feathers, or even dry hay, &c. and placed in a basket, may be carried in the hand on that side to which the sun's rays are directed, with every prospect of success; very small eggs may be wrapped up and carried in the bosom. But of all the methods the hat offers the best resource, from the regular heat imparted by means of the head. We have known this successfully practised in several instances with pheasants', partridges', plovers', and even wild ducks' eggs; and we are pleased to find our testimony on the subject corro-

borated by a correspondent of Mr. Loudon's, who observes,—“A few years ago, whilst crossing a healthy country, my horse trod up a widgeon; and on getting off to examine the spot, I found a nest with about eight eggs. I took off my hat, and put some dry herbage into it, upon which I placed the lining of the nest with the eggs, dividing one from the other by a little of the lining; upon which I put more of the herbage, and thrust my head carefully into my hat, and rode quietly home, about the distance of six miles; and from the time I found the eggs until I could procure a hen was about the space of two hours and a half; and in about one week the birds were hatched. I have since tried the experiment on eggs mowed or reaped over in the harvest time, and found it to answer; the warmth of the head in the hat being of sufficient temperature to prevent the eggs from spoiling, taking care to walk or ride quietly until a hen can be found.”

ORES OF MERCURY.

MERCURY, commonly called quicksilver, is found native in the pure metallic state, but the source from whence the greater portion is obtained, is from the sulphuret of the metal or native cinnabar. Fluid mercury is between tin and silver white. It is collected in globules in cavities, or holes dug in the earth for the purpose. The principal mines which furnish this metal, are those in Idris, Deux Ponts, Almaden, and Guanica Vellica; it is not peculiar to any one soil, being found in quartz, indurated clay, argillaceous schistus, calcareous spar, &c.

The ores of mercury may be divided into—

Metallic mercury.	
Native amalgam.	Mercury and silver.
Cinnabar.	Mercury and sulphur.
Horn mercury.	Mercury oxygen, muriatic and sulphuric acids.

In the state of fluid, semi-fluid, crystallized, massive, fibrous, pulverulent, investing, &c. Most of the ores of mercury are readily distinguished from those of any other metal; in the first variety globules of the metal are seen attached to or just starting on the surface, which is at once a sufficient criterion, mercury being unlike every other metal; in the second, by the fine white color, and the action of the blow-pipe, which sublimes the mercury and leaves the silver behind; the third, by its beautiful deep red tint, varying from cochineal to scarlet red, excepting in those termed hepatic cinnabars, which are generally of a lead grey; the fourth, by its light grey color, its partial solubility in water, and its complete volatilization by heat, emitting at the same time an arsenical odour. Before the blow-pipe, these varieties burn with a blue flame and sulphurous odour, leaving more or less residue behind them, and which may consist of earthy matter, as siliceous and alumina, together with the oxides of iron and copper. The specific gravity of the mercurial ores varies from 6.5 to 10.5; that of the pure metal, as revived from its oxide, being 13.5.

Analysis.—The analysis of the ores of mercury is very simple, seldom containing more than six, and often only two foreign substances. The analysis of the native mercury need hardly be mentioned, as, however, it sometimes contains a minute portion both of silver and bismuth, it may be thus conducted:—

Process 1.—Place a small portion, say 100 grains, in a small flask set in the retort stand, pour upon it by small quantities at a time, pure nitric acid a little diluted until the whole is dissolved, pour this into another glass vessel holding about a pint of clean distilled water, the oxyde of bismuth will fall, filter, and collect; wash until tasteless; dry and weigh. The washings of the filter being added to the other solutions, the whole is to be evaporated to one half; when, if any further precipitate is given, it is to be collected as in the preceding and added to it.

2.—The solution now containing only silver and mercury, is to be decomposed by common salt, chloride of silver will fall; collect, &c. as before.

3.—The washings having been added to the remaining solution, carbonate of potassa, will throw down the mercury, which when heated with a little charcoal will give the metal in a fluid state.

Native amalgam.—The analysis of the native amalgam is precisely the same, the foreign matters only entering in larger quantities; for the sake of variation, the following method may be adopted.

Process 1.—Proceed exactly as in process 1 of the former analysis, which will get rid of the bismuth; and evaporate to dryness.

2.—Mix the dry residue, consisting of the oxydes of silver and mercury, with a little charcoal powder, and submit to a low red heat in a coated retort; the mercury will distil over, and a button of silver will remain behind.

Native cinnabar.—The analysis of native cinnabar, or sulphuret of mercury, may be thus effected.

Process 1.—A given weight of the ore reduced to powder is to be digested with heat in hydrochloric acid, adding occasionally a few drops of nitric acid to effect a solution; when the action of the acid ceases, and a few drops more of fresh nitric acid produce no effect, pour off the clear liquor, edulcorate the residue, and dry with a gentle heat; this will consist of the sulphur with any siliceous matter insoluble in the acid, the separation of which may be readily effected by heating them in a platina dish or the bowl of a tobacco pipe, the sulphur will then burn off, and the loss in weight upon re-weighing will indicate the quantity contained.

2.—The nitric solution is now to be tested, and if found to contain only mercury, iron, and copper, the solution may be evaporated to dryness, taking care not to give so much heat as would decompose the mercurial salt; upon resolution in distilled water the chief part of the iron will be left behind in the state of peroxide.

3.—Immerse into the solution a clean plate of iron, and gently heat it, the mercury and copper will fall down; the precipitate thus obtained is to be well washed, dried, weighed, and ignited, the residue left after this will be the copper, and the difference in weight before and after ignition will give that of the mercury.

Horn Mercury.—This variety is a mercurio-sulphate of the metal, and its constituent parts may be thus ascertained:—

Process 1.—Having reduced a portion to fine powder, digest it in good acetic acid; if any metallic mercury has previously existed, interspersed through the substance of the ore, it will be left behind, and is to be collected, washed and dried.

2.—To the clear solution add nitrate of barys, which will throw down a white powder, the sulphate of barys, collect, well wash and dry on a filter; every 100 parts indicate 34 of dry sulphuric acid, or thirteen and a half of sulphur.

3.—Add the washings of the last precipitate to the remaining solution, and drop in nitrate of silver until no further precipitation takes place: this is the chloride of silver; 100 parts of which, when washed and dried, are equal to 25 of acid.

4.—Add the washings of the last process as before, and precipitate the mercury still in solution by a plate of clean iron. The powder obtained when dried and triturated will assume its characteristic fluidity.

CULTIVATION OF FERNS

From the Analysis of British Ferns, by G. FRANCIS, Author of the Little English Flora, &c. [Second Edition, just published.]

THIS tribe of plants was but a few years ago scarcely known in cultivation. Lately, however, it has been considerably sought after; and as little has hitherto been written on the culture of Ferns, or the selection of species, the following general observations will, I trust, be acceptable.

Sowing.—For sowing Fern seed, the spring of the year is to be preferred. The pots in which it is to be sown should be of a small size, (say 48s.) both for the sake of convenience, and because they hold less moisture, and allow a better circulation. Fill the pots half full of fine broken pot-shreds; that is, garden-pots broken into small pieces. Over these lay a portion of Sphagnum, or other porous moss, and then fill the pot to within half an inch of the top, with soil prepared in the following manner:—Take three parts of loose or unadhesive peat earth, (that is to be chosen which lies about an inch beneath the surface, where it is not too much decayed) put it into a pan of boiling water, to kill any vegetable matter that may be alive, or small worms, which become very troublesome as the Fern seeds vegetate; then let it dry enough to rub through the hand, but not very finely; to this powdered peat add one-third of white sand, mixing both articles well together. When the pots are filled to within half an inch of the top, give them a little water, on which sow the seeds, taking care not to water them afterwards over the top. The seeds should be sown thinly; if thickly sown, or too much water be given, they are apt to *fog*, or kill each other, before they are large enough for potting or pricking off. After sowing, lay a piece of common glass over the top of the pot, and set it in a saucer, taking care not to let the saucer be without water, and place it in a light but shaded place. When the plants have shown the first leaf, a little air may be admitted; after which, should they be too thick, they may be thinned by taking them up in small patches with the point of a knife, and transplanting them into another pot, prepared as the former, but made fine by sifting the soil; when large enough, they may be divided a second time. Many persons mix a great portion of broken brick in the seed pot, upon which the seeds vegetate well, but the difficulty of transplanting therefrom is very great. It is of course necessary to know whether the species belong to the green-house or stove, that the vegetating seed may be placed in a congenial climate, observing only that a dry air and direct sunshine is to be, as much as possible, avoided.

After-cultivation.—Ferns of different habit require a different treatment. This is in some degree accordant with their natural soil and places of growth, yet not wholly so. Numerous of the

British Ferns, although they naturally live in bleak and exposed situations, yet when under culture require some degree of protection. So, also, notwithstanding some of them seem naturally to prefer the interstices of brick-walls, such, for example, as *Grammitis oterach*, they will not flourish in brick rubbish. To treat this little understood part of the subject intelligibly, and to show the extent to which the foregoing observation applies, it is advisable to divide the Ferns into various distinct sections, as follows :—

STOVE AND GREEN-HOUSE FERNS.

Ferns with rhizomas.—These in their native habitats are, in many instances, epiphytes, deriving their nourishment chiefly from the air, or from other scanty sources. If potted, they require much less water than others, the soil should be porous, and the pots should be filled half full of turfy peat. Most of this division thrive very well suspended on blocks of wood, in a warm moist atmosphere, but should be watered very sparingly in the winter season. The small, creeping, entire-leaved species thrive as epiphytes, as they run a long way in the season. These are readily increased by cuttings. If potted, they seldom show any fructification, owing to their stunted habits.

Ferns with crowns.—Those Ferns with crowns from which the fronds issue, require a soil made finer, with a greater depth. Care must be taken in not covering their crowns, which is certain death to the greater number of the species; they likewise require more frequent watering, as they are sooner affected by drought. Many of this section produce bulbs upon their leaves, from which they readily increase. Others root from the tip of their fronds, without forming bulbs; such is the case with many of the *Aspleniums*. This section requires care in dividing, as by this mode they seldom make good plants; it is preferable to increase them from seed, as they grow more freely, and make finer plants. The *Gymnogrammas* should be potted in loam, as they are very apt to damp if potted in peat soil; in fact, most Ferns which have various-colored leaves prefer a loamy soil. No kind of manure should be at any time given to Ferns; even weak lime-water should be avoided, as great havoc is sometimes made with it.

Ferns with thick fleshy roots.—Of these there are but a few species. All those of *Marattia* have a curious scaly-cormus, resembling that of the genus *Zamia*, from which are produced strong thick fleshy roots. They prefer loam and peat, and are easily injured by shifting, as the soil is very apt to drop from them when they are turned out of the pot. If kept too hot they are apt to drop their leaves; they do best in a temperature not exceeding 60°. *Danaeas* resemble the last genus, and require the same treatment. Care must be taken to give them free draining.

Arborescent Ferns.—In general these do not thrive well; they require a very moist atmosphere. Their stems should always be bound with *Sphagnum*, or they soon look very sickly, as they are covered all up their stem with spongeoles, by which they, in a great degree, receive their nourishment. They should be well drained, and freely syringed on their stems to keep the moss moist.

Numerous of the Ferns under stove culture are infested with a species of thrips; others have a

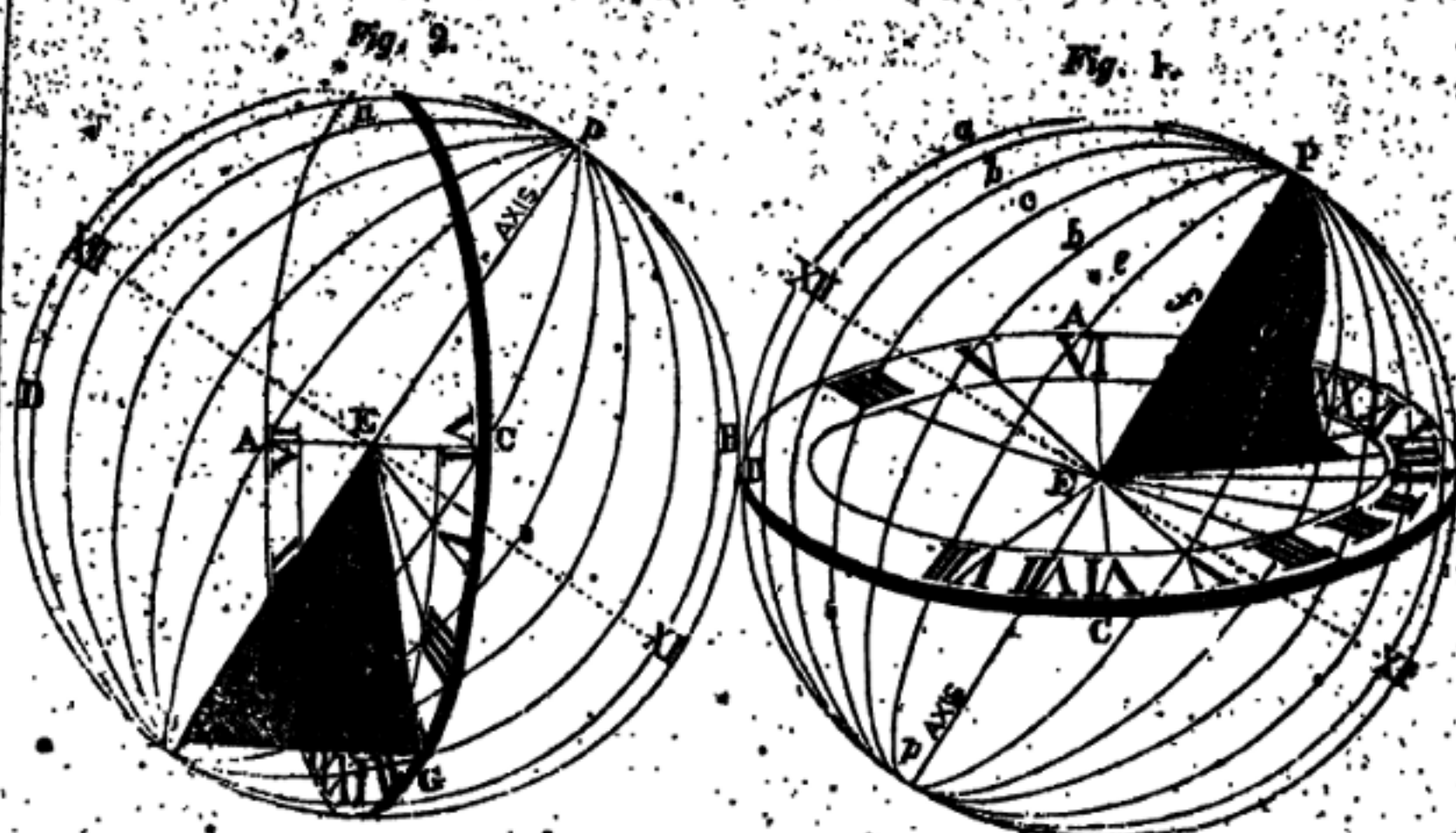
rusty appearance, often laid to that insect, but which appears to arise from being kept too warm—the green-house species, mixed with those properly belonging to the stove, being always first attacked. Other insects seldom attack them, with the exception of brown scale and slugs, which are soon destroyed. The best remedy for the thrips is the vapor arising from sulphur sprinkled over the flues or pipes.

HARDY FERNS.

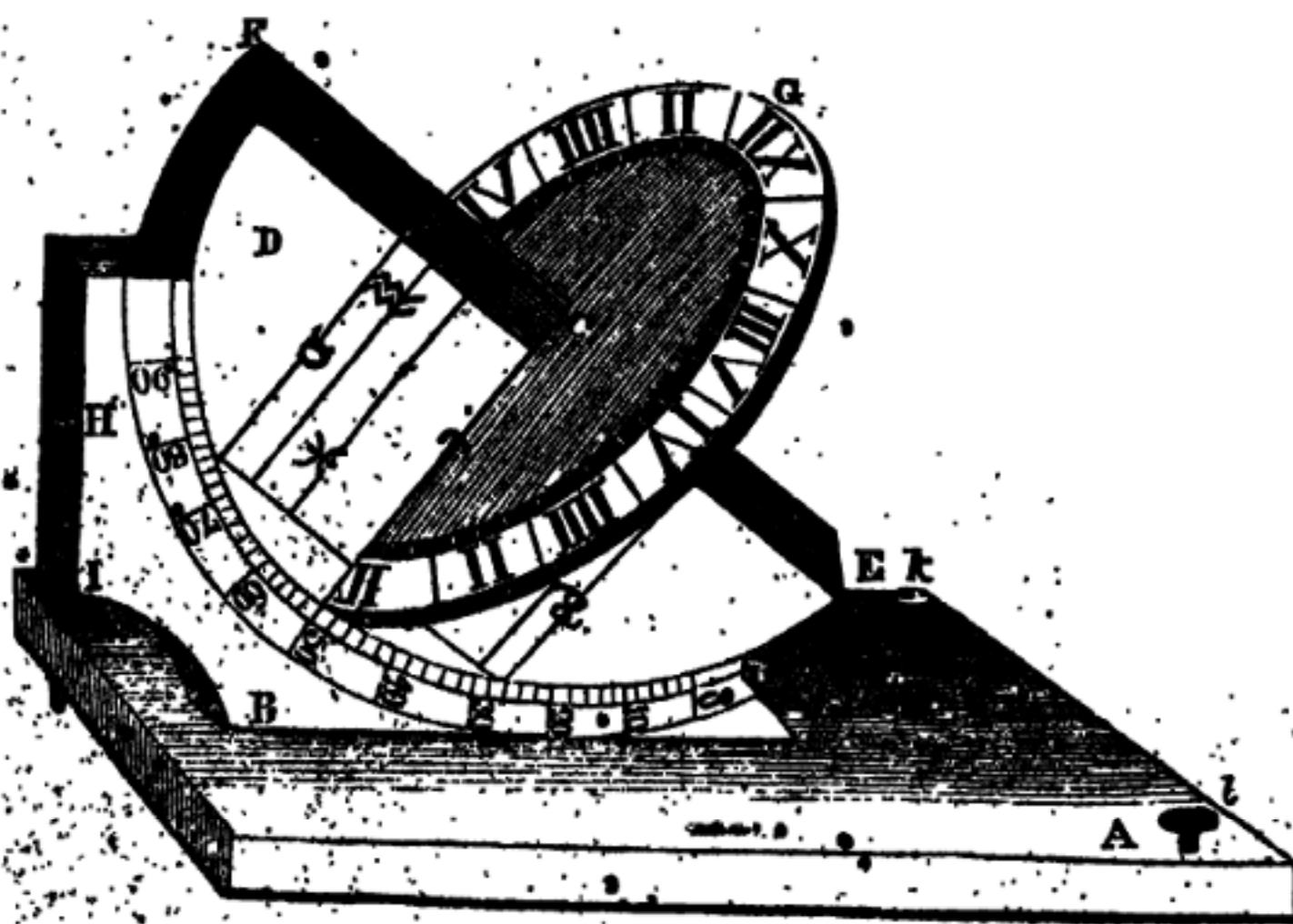
Hardy Ferns should always have a prepared soil on a sloping north bank, where they are seen to the greatest advantage. Some of the strong *Aspidiums* will grow in any common soil, where the small species would soon perish. They prefer a shady place, but do not like the drip of trees, nor stagnant water about them. The border or soil should be made of one-fourth coarse grit or river sand, with three parts peat or bog earth, chopped well in pieces, but not sifted; this should be a foot deep. If a very damp place, the border should have a layer of broken brick below to drain it, if intended for the more choice species; for although *Osmundas*, *Aspidium thelipteris*, and *Blechnum boreale* will grow in the water, they thrive better a small distance off, and you gain the advantage of growing all the species in the same border. Some of the smaller species should be raised on mounds above the border to keep them drier; the best way is to place four or five stones edgewise, thereby forming a hollow in the centre, putting a little drainage in the bottom. Small species prefer shallow soil; they are likewise benefited by placing a bell-glass over them, to retain the humidity of the atmosphere. Many of them it is difficult to find situations suitable for, without covering both in summer and winter; such for instance as *Adiantum capillus-Veneris*; *Asplenium alternifolium*, *viride*, *trichomanes*, *septentrionale*, and *marinum*; *Hymenophyllum Wilsoni* and *Tunbridgensis*; *Trichomanes brevisetum*; *Ceterach*, and many small foreign species; likewise the *Lycopodiums*, the hardy species of which may all be grown. *Hymenophyllums* and *Trichomanes* require but little soil; they thrive best fastened on a piece of porous stone, over which has been shaken a little sand. They should always be covered with a glass, and kept very moist and shaded, being inhabitants of wet dripping rocks. Many of the other small species grow in drier situations, even on sunny walls, but they are always finer in the shade; from such situations they are difficult to remove, owing to the roots penetrating the crevices of the wall or rock, and take a long time to get thoroughly established in a new situation. The *Botrychiums* are also removed with difficulty.

Fern Houses.—The plan adopted by Mr. Ward, (of Wexham Square, London,) is deserving of particular attention from many causes, independent of the cultivation of the Ferns. The principle established by this excellent and well-known botanist is, that a constant renewal of air is not necessary for the well-being of plants. Thus if a plant be inclosed in a glass case, watered, and then the case closed up air-tight, the moisture which evaporates having no means of flying off will be condensed on the sides of the case, and trickling down will moisten the plants a second time, only to be evaporated and condensed again and again each succeeding day.

[We have given a full description of these Fern-houses in Vol. II.—ED.]



THE PRINCIPLES OF DIALLING.



PRINCIPLES OF DIALLING.

A **DIAL** is a plane upon which lines are described in such a manner that the shadow of a wire, or of the upper edge of another plane, erected perpendicularly on the former, may show the true time of the day. The edge of the plane, by which the time of the day is found, is called the *stile* of the dial, which is always parallel to the earth's axis; and the line on which the said plane is erected is called the *substile*. The angle included between the substile and stile is called the *elevation*, or *height* of the stile. Those dials whose planes are parallel to the plane of the horizon are called *horizontal dials*; and those dials whose planes are perpendicular to the plane of the horizon are called *vertical*, or *erect dials*. Those erect dials whose planes directly front the north or south are called *direct north* or *south dials*; and all other erect dials are called *decliners*, because their planes are turned away from the north or south. Those dials whose planes are neither parallel nor perpendicular to the plane of the horizon are called *inclining*, or *reclining dials*, according as their planes make acute or obtuse angles with the horizon; and if their planes are also turned aside from facing the south or north they are called *declining-inclining*, or *declining-reclining dials*. The intersection of the plane of the dial with that of the meridian, passing through the stile, is called the *meridian* of the dial, or the *hour-line* of XII. Those meridians whose planes pass through the stile, and make angles of 15° , 30° , 45° , 60° , 75° , and 90° degrees with the meridian of the place, (which marks the hour-line of XII,) are called *hour-circles*; and their intersections with the plane of the dial are called *hour-lines*.

If the whole earth $a P C p$ were transparent and hollow, like a sphere of glass, and had its equator divided into twenty-four equal parts by so many meridian semi-circles, a, b, c, d, e, f, g , &c., one of which is the geographical meridian of any given place as London, (which is supposed to be at the point a), and if the hours of XII were marked to the equator,) both upon that meridian and the opposite one, and all the rest of the hours in order on the rest of the meridians, these meridians would be the hour-circles of London; then, if the sphere had an opaque axis $a P E p$, terminating in the poles P and p , the shadow of the axis would fall upon every particular meridian and hour, when the sun came to the plane of the opposite meridian, and would consequently show the time at London, and all other places on the meridian of London.

Horizontal dial.—If this sphere was cut through the middle by a solid plane $A C D$, in the rational horizon of London, one half of the axis $E P$ will be above the plane, and the other half below it; and if straight lines were drawn from the centre of the plane, to those points where its circumference is cut by the hour circles of the spheres, these lines would be the hour lines of a horizontal dial for London; for the shadow of the axis would fall upon each particular hour line of the dial when it fell upon the like hour circle of the sphere.

Vertical dial.—If the plane which cuts the sphere be upright, as $a F C G$, Fig. 2, touching the given place, (London,) at a , and directly facing the meridian of London, it will then become the plane of a direct south dial; and if right lines be drawn from its centre E to those points of its circumference where the hour circles of the sphere cut it; these will be the hour lines of a vertical or direct

south dial for London, to which the hours are to be set as in the figure, (contrary to those on a horizontal dial,) and the lower half $E p$ of the axis will cast a shadow on the hour of the day in this dial, at the same time that it would fall upon the like hour circle of the sphere, if the dial plate was not in the way.

Inclining and reclining dials.—If the plane, (still facing the meridian,) be made to incline, or recline, any given number of degrees, the hour circles of the sphere will still cut the edge of the plane in those points, to which the hour lines must be drawn straight from the centre; and the axis of the sphere will cast a shadow on these lines at the respective hours. The like will still hold, if the plane be made to decline any given number of degrees from the meridian towards the east or west; provided the declination be less than 90° or the reclination be less than the co-latitude of the place; and the axis of the sphere will be a gnomon, or stile, for the dial. But it cannot, when the declination is quite 90° degrees, nor when the reclination is equal to the co-latitude; because in these two cases, the axis has no elevation above the plane of the dial. And thus it appears, that the plane of every dial represents the plane of some great circle upon the earth; and the gnomon the earth's axis, whether it be a small wire, or the edge of a thin plate, as in the common horizontal dials.

The whole earth, as to its bulk, is but a point if compared to its distance from the sun: and, therefore, if a small sphere of glass be placed upon any part of the earth's surface, so that its axis be parallel to the axis of the earth, and the sphere have such lines upon it, and such planes within it, as above described; it will show the hours of the day as truly as if it were placed in the earth's centre, and the shell of the earth were as transparent as glass.

An universal dial.—There are several kinds of dials which are called *universal*, because they serve for all latitudes. Of these, the best one is Mr. Pardies, which consists of three principal parts; the first whereof is called the *horizontal plane* A , Fig. 3, because in practice it must be parallel to the horizon. In this plane is fixed an upright pin, which enters into the edge of the second part $B D$, called the *meridional plane*; which is made of two pieces, the lowest whereof B is called the *quadrant*, because it contains a quarter of a circle, divided into 90° degrees; and it is only into this part, near B , that the pin enters. The other piece is a *semicircle* D adjusted to the quadrant; and turning in it by a groove, for raising or depressing the diameter $E F$ of the semicircle, which diameter is called the *axis* of the instrument. The third piece is a *circle* G , divided on both sides into 24 equal parts, which are the hours. This circle is put upon the meridional plane so that the axis $E F$ may be perpendicular to the circle; and the point C be the common centre of the circle, semicircle, and quadrant. The straight edge of the semicircle is chamfered on both sides to a sharp edge, which passes through the centre of the circle. On one side of the chamfered part, the first six months of the year are laid down, according to the sun's declination for their respective days; and on the other side, the last six months. And against the days on which the sun enters the signs, there are straight lines drawn upon the semicircle, with the characters of the signs marked upon them. There is a black line drawn along the middle of the upright edge of the quadrant, over which hangs a thread H , with its plummet I , for levelling the instru-

ment. N.B. From the 23rd of September to the 20th of March, the upper surface of the circle must touch both the centre C of the semicircle, and the line of γ and α ; and from the 20th of March to the 23d of September, the lower surface of the circle must touch that centre and line.

To find the time of the day by this dial. Having set it on a level place in sun-shine, and adjusted it by the levelling screws K and I, until the plumb line hangs over the black line upon the edge of the quadrant, and parallel to the said edge; move the semicircle in the quadrant, until the line of γ and α (where the circle touches) comes to the latitude of your place in the quadrant: then, turn the whole meridional plane B D, with its circle G, upon the horizontal plane A, until the edge of the shadow of the circle falls precisely on the day of the month in the semicircle; and then, the meridional plane will be due north and south, the axis E F will be parallel to the axis of the world, and will cast a shadow upon the true time of the day, among the hours on the circle.

N. B. As, when the instrument is thus rectified, the quadrant and semicircle are in the plane of the meridian, so the circle is then in the plane of the equinoctial. Therefore, as the sun is above the equinoctial in summer, (in northern latitudes) and below it in winter; the axis of the semicircle will cast a shadow on the hour of the day, on the upper surface of the circle, from the 20th of March to the 23rd of September: and from the 23rd of September to the 20th of March, the hour of the day will be determined by the shadow of the semicircle, upon the lower surface of the circle. In the former case, the shadow of the circle falls upon the day of the month, on the lower part of the diameter of the semicircle; and in the latter case, on the upper part.

ELECTRIFYING PLANTS.

MANY experiments in electrifying plants have been made by M. Nuneberg and the Abbe Nollet; according to the former, most of them increased in height, and flourished far beyond others not electrified. Some bulbous roots, he says, which had been frequently electrified, grew eighty-two lines and a half; whilst others of the same species, not electrified, grew only in the same period fifty-two lines and two-thirds. But the report of Abbe Nollet is not so favorable; he found that the plants electrified by him at first made vigorous shoots, but he thought their perspiration being, by these means, too much increased, their juices might have been too quickly dissipated; in consequence of which the plants became gradually weak, and at length prematurely perished. We do not hesitate yielding due credit to both these reports, although they seem in some measure incompatible with each other. They may have been made on various plants, at different seasons. M. Nuneberg therefore might have succeeded, although those of the Abbe in some measure failed. Besides, when administered by art, either to animal or vegetable bodies, the electricity may be given when the plants may already have the proper natural quantity; and therefore, in some instances, it may be too strong; in others not strong enough, not sufficiently diffused, or it may not be applied to the proper part. The various modifications of electricity cannot well be comprehended, excepting by those who profess considerable knowledge of the theory, and likewise the practice of it

so as to judge of its effects, not only in the atmosphere, but likewise on all animal and vegetable bodies: some of them may benefit by the aura, or mild state of the fluid; and yet be injured by a spark, or even be killed by a severe shock.

MOULTING OF THE CRAY FISH.

THE phenomena which attend the renovation of the external skeleton are so unimaginable that it is really extraordinary how little is accurately known concerning the nature of the operation. The first question which presents itself, is, how are the limbs liberated from their confinement? For, wonderful as it may appear, the joints even of the massive *chela* of the lobster do not separate from each other, but notwithstanding the great size of some of the segments of the claw, and the slender dimensions of the joints that connect the different pieces, the cast-off skeleton of the limb presents exactly the same appearance as if it still encased the living member. The only way of explaining the circumstance is to suppose that the individual pieces of the skeleton, as well as the soft articulations connecting them, split in a longitudinal direction, and that, after the abstraction of the limb, the fissured parts close again with so much accuracy that even the traces of the division are imperceptible. But this is not the only part of the process which is calculated to excite our astonishment; the internal calcareous septa from which the muscles derive their origins, and the tendons whereby they are inserted into the moveable portions of the outer shell, are likewise stated to be found attached to the exuvium; even the singular dental apparatus situated in the stomach, (of which we shall speak hereafter,) is cast off and re-formed. And yet, how is all this accomplished? How do such parts become detached? How are they renewed? We apprehend that more puzzling questions than these can scarcely be propounded to the physiologist, nor could more interesting subjects of inquiry be pointed out to those whose opportunities enable them to prosecute researches connected with their elucidation.

The following description of the appearance of an *Astacus fluviatilis*, obtained soon after casting its shell, and of its newly cast-off covering, will be found interesting:—All the pieces of the exuvium are connected together by the old articulations, and accurately represent the external form of the complete animal; the *carapace*, or dorsal shield of the cephalo-thorax alone being detached, having been thrown off in one piece. The pedicles of the eyes and external cornea, as well as the antennae, remain *in situ*; the corresponding parts having been drawn out from them as the finger from a glove, and no fissure of the shell or rupture of the ligaments connecting the joints is anywhere visible in these portions of the skeleton. The ordinary tubercles, and the membrane stretched over the orifice of the ear, occupy the same position as in the living cray fish. The jaws, foot-jaws, and ambulatory feet, retain their original connections, with the exception of the right *chela*, which had been thrown off before the moult began; and the segments of the abdomen, false feet, and tail-fin, exactly resembled those of the perfect creature;—even the internal processes derived from the thoracic segments, (*apodemata*.) rather seemed to have had the flesh most carefully pinked out from among them than to have been cast away from a living animal: but perhaps the most curious circumstance observable was, that attached

to the base of each leg was the skin which had formerly covered the branchial tufts, and which, when floated in water, spread out into accurate representations of those exquisitely-delicate organs. No fissure was perceptible in any of the articulations of the small claws, but in the chela each segment was split in the neighbourhood of the joints, and the articulated ligaments ruptured. The lining membrane of the stomach was found in the thorax, having the stomachal teeth connected with it; from its position it would seem that the animal had dropped it into the place where it lay before the extrication of its limbs was quite accomplished. The internal tendons were all attached to the movable joint of each pair of forceps, both in the chela and in the two anterior pairs of smaller ambulatory legs. On examining the animal, which had extricated itself from the exuvium described above, the shell was found soft and flexible, but contained a sufficiency of calcareous matter to give it some firmness, especially in the claws. The tendons of the forceps were still perfectly membranous, presenting a very decided contrast when compared with the old ones affixed to the discarded shell. The stump of the lost chela had not as yet begun to sprout, and the extremity was covered by a soft black membrane. The jaws were quite hard and calcified, as likewise were the teeth contained in the stomach.

CONSTRUCTION OF GAS BURNERS.

In order to obtain the greatest quantity of light which the burning of gas is capable of affording, it is essential that its combustion should be perfect; therefore, the construction of the instruments by which it is effected, requires peculiar care and attention. It is desirable that their orifices should be exactly the size which will allow the stream of gas to flow in such a manner, that its flame may readily come in contact with the atmospheric air, to combine with the oxygen contained in it; for when the gas and common air mix in due proportion in the flame, its temperature is elevated to that degree which effects the complete decomposition of the gas and occasions it to be wholly consumed. Indeed, the quantity and the vividness of the light materially depend upon the gas having a proper supply of air when it is inflamed, and as these are regulated so as to have a due relation to each other, the gas is effectually burnt, and consequently the greatest possible portion of light is produced which it is capable of yielding.

Gas burners are of different kinds, varying both in their form and the number of their orifices; and, when they have more than a single hole, each hole is of precisely the same diameter. It is necessary also, that all the holes in the same burner should be not only of the same size, but perfectly round and smooth, that the flow of the gas may be steady and regular, to render the flame uniform and even; for if a burner consists of apertures varying in their size and smoothness, the flame produced is not only irregular, but ragged. When the holes are placed in a circle, as in the Argand burner, great care is observed that the distance of the holes from each other is invariably equal, and that every hole has exactly the same diameter. Besides, in properly-constructed burners, the holes are arranged in such a manner that all the jets of flame may unite near to the bottom, so as to form one uniform cylinder of light; and hence the superiority of this

kind of burner. The number of the holes in a burner depends upon its size, as well as the kind of gas for which it is intended to be used; and both are also regulated by the magnitude of the circle in which they are disposed. Should the holes be too large, the gas will flow in such quantities as to be disproportionate to the supply of atmospheric air, which in that case renders the combustion of the gas imperfect, and of course affects the brilliancy of the light and produces smoke. On the contrary, it is essential that the apertures should not be too small, lest the gas should not flow in a sufficient stream to produce the required quantity of light; but their size depends upon various circumstances, as well as the nature and properties of the gas, which will occasionally render slight variations necessary. It will be remarked that, within a certain limit, the burners which contain the greatest number of holes afford the most brilliant light.

The aperture in the centre of an Argand burner is intended for regulating the supply of the interior part of the cylinder of flame with a proper quantity of atmospheric air; and the use of the glass chimney is not only to preserve the flame steady, but also to render the combustion of the gas more active, and its decomposition more complete.

The following remarks, respecting the construction of burners, the length of flues, &c., are extracted from a paper read to the Royal Society of Edinburgh, by Drs. Christison and Turner; but it may be proper to notice that they relate chiefly to gas of the purest quality, and of high specific gravity:—The diameter of the hole for a single jet, for coal gas, should be $\frac{1}{8}$ of an inch; for oil gas, $\frac{1}{4}$ inch. The diameter of the hole for Argand burners, when the holes are 10 in a circle of $\frac{1}{4}$ of an inch radius, should be about $\frac{1}{16}$ inch for coal gas, of the specific gravity from 550 to 650; and for oil gas of the same radius of circle, and the number of holes 15, $\frac{1}{16}$ inch, when the specific gravity is between 900 and 1000; but if the gas be of the specific gravity of 680, about $\frac{1}{16}$ inch. The distance of the holes, which are $\frac{1}{16}$ inch diameter, should be from $\frac{1}{16}$ to $\frac{1}{8}$ inch. The diameter of a circle of holes, or the size of the burner, is regulated by the number of holes: hence, oil-gas burners having 10, 15, 20, 25 holes, should have their circles $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$ inch diameter; breadth of rim $\frac{1}{16}$ inch, and length of burner $1\frac{1}{2}$ inch. An advantage is gained, in some cases, in proportion as the holes approach each other nearer and nearer: viz., in those that have a circle $\frac{1}{4}$ in. diameter, with 10, 15, 20 holes $\frac{1}{16}$ inch diameter; but no advantage is gained by burners of this size when the holes are only 8, or more than 20. The burners of a public company are always constructed so as to burn at some loss; and on this account the number of holes in a circle of $\frac{1}{4}$ inch diameter should not exceed 15.

Coal-gas burners do not require so many holes as oil gas, because the greater width of the drill compensates for the diminution of the number, so that the jets still meet perfectly, and form an uniform cylinder of flame; but if the holes are made less in diameter they must be increased in number. The diameter of the air-hole is regulated by the diameter of the circle of holes; but as that increases the supply of air increases in a greater ratio than the flow of the gas; and therefore the circumstance suggests, that it might be advantageous to lessen the supply of air by shaping the air canal like an inverted cone. The height to which the flame may be raised without smoking, or the elevation at which

it gives light relatively to the quantity of gas consumed, differs very much in different burners.

Holes.	Height of Flame.
In burners having 8, the maximum is at 4 inches.	
" " 10, " " "	3½ "
" " 15 and 20, " " "	2½ "
" " 25, " " "	2 "

It is remarked as a singular fact, that all these burners emit nearly the same quantity of light; that the most brilliant, and, at the same time, the most economical kind is produced when the jet holes are very numerous, the air aperture small, and the chimney narrow; and that when several jets are united together, as in an Argand burner, the light increases in a greater ratio than the expenditure of the gas. The glass chimneys for the four sized burners should be $\frac{7}{8}$, $\frac{1}{8}$, $\frac{1}{8}$, $\frac{1}{8}$ inch diameter, and 6 inches in length.

ORIGIN OF TERRESTRIAL MAGNETISM.

SEVERAL causes have been assigned for the magnetic influence which the globe of the earth is found to exercise, not only over the magnetic needle, but also, over currents of voltaic electricity transmitted through conductors. Among the various substances which occupy the interior of the globe it is extremely probable that chemical actions of different kinds are incessantly occurring. These actions will, for the most part, however, be very slow, and will continue with a certain degree of uniformity for very extended periods of time. They will occur more especially in the superficial strata of the earth, where the combined agencies of water, of atmospheric air, and of heat are in constant operation. The influence of the solar rays on a surface of such vast extent must be very considerable: and excepting in the vicinity of the poles, every portion of that surface is exposed in succession to their action, and acquires during that exposure a certain degree of heat; which heat is again lost by nocturnal radiation. Although the effect of these alternate changes of temperature may extend only to a small depth below the surface, yet considering their immense superficial extent, they may be sufficient to give rise to thermo-electric currents of considerable power. It has been conjectured, also, that these effects may be combined with an influence of another kind, more directly derived from the rotation of the earth on its axis, on the principle that all bodies have been found to exhibit magnetic polarity by rotation.

That electric currents do really circulate in different parts of the solid strata of the earth is not merely matter of conjecture: the existence of such currents has been lately proved, in the most satisfactory manner, by Mr. Robert Fox, in a paper "On the electro-magnetic properties of metalliferous veins," which has been recently published in the "Philosophical Transactions." Having been led from theory to entertain the belief that a connexion exists between electric action in the interior of the earth, and the arrangement of metalliferous veins, he was anxious to verify this opinion by experiment. The first trials he made with this view were unsuccessful: but by persevering in his attempts, he soon obtained decisive evidence of considerable electrical action in the mine of Huel Jewell, in Cornwall. His apparatus consisted of small plates of sheet copper, which were fixed in contact with ore in the veins by copper nails, or else wedged closely against them by wooden props stretched across the galleries

of the mine. Between two of these plates, at different stations, a communication was made by means of copper wire, one twentieth of an inch in diameter, which included a galvanometer in its circuit. In some instances 300 fathoms of copper wire were employed.

The intensity of the electric currents was found to differ considerably in different places. It was generally greater in proportion to the greater abundance of copper ore in the veins, and in some degree also to the depth of the station. This curious fact may possibly afford the miner some useful indications as to the relative quantities of ore which the vein contains, and also as to the directions in which it is most productive. The electricity thus perpetually in action does not appear to be in any respect influenced by the presence of the workmen and their candles; nor even by the explosions of gunpowder in blasting. Mr. Fox observes that ores which transmit electricity have generally some conducting material interposed in the veins between them and the surface: a structure which appears to bear some analogy to the ordinary galvanic combinations. These electrical currents which pervade mines were found to have various and frequently opposite directions in different parts of the same mine.

The metals are probably not the only substances capable of giving rise to electrical currents in the earth; for it is well known that galvanic combinations may be formed by arrangements of elements that are not metallic. The direction of each current will of course be determined by the relative positions of the elements from which it is derived; but even if we suppose the arrangement of these elements to be fortuitous, a prevailing current will still result, arising from the difference of their actions; for it is infinitely improbable that, without a designed arrangement, the currents in opposite directions should be exactly equal, so as to destroy one another. Irregularities of distribution probably exist with regard to the materials composing the interior of the globe; the resultant electro-magnetic action of the whole combination being that of which we witness the effects, and which may be considered as due to electrical currents circulating in directions parallel to the magnetic equator, round the surface of the earth.

Even in the irregularities incident to the magnetic forces derived from the earth we may discern the operation of causes which are periodical in their operation. Thus the diurnal and annual changes of the variation of the needle may be traced to corresponding changes in the position of the different parts of the earth with regard to the sun, in as far as these electric currents are dependent upon solar influence. The progressive changes in the variation, which embrace longer periods of time, are less easily accounted for, and appear referable to causes which act at greater depths below the surface of the earth; and are probably connected with chemical changes taking place in the interior of the globe, of which we possess no certain knowledge. On the whole, then, it must be allowed, that there are strong grounds for the belief that there subsists some mutual connexion, or rather an intimate relation and affinity, between the several imponderable agents, namely, *Heat, Light, Electricity, and Magnetism*, which pervade in so mysterious a manner all the realms of space, and which exert so powerful an influence over all the phenomena of the universe.

CANADIAN TIMBER.

IN Mr. Montgomery Martin's third volume of the "History of the British Colonies," embracing the possessions in North America, a great body of most important statistical information is to be found. In those sections that are devoted to the vegetable kingdom, the forests of Canada, of course, obtain considerable notice. The writer is a warm advocate in support of our Colonial interests, but of none is he more so than those parts now alluded to. Indeed, he maintains that our independence as a maritime power, as far at least, as regards supplies of timber for our navy, is bound up (in case of a war with the northern powers of Europe) with a due protection and encouragement of the Canadas. The dense forests that cover great part of the surface of these possessions are also a mine of wealth, as an article of traffic, to England. We shall extract a few of Mr. Martin's descriptions, respecting particular kinds of trees abounding in these Colonies.

The principal timber trees of Canada, are, in the low and light sandy soil, almost every species of pine, with cedars and swamp ash. The dry and more elevated land yields oak, elm, ash, and birch of various kinds—maple, walnut, cherry (various kinds), hickory, hazel, iron-wood, thorn, &c. The pines and firs are the great staple of the forests. We quote what is said of the balsam spruce, on account of its curious usefulness.

"A beautiful evergreen tree, in open situations feathered to the ground, and rising in a pyramidal shape to the height of thirty feet or more; and, on these accounts, much planted for shrubbery and park scenery in Great Britain. The famous *Canada Balsam* is procured from this tree; it is found in small blisters in the bark, extracted by incision, and received in a limpid state into a shell or cup.

"Perhaps there is not a better varnish for water-color paintings, than that which is prepared from this liquid resin. The branches of this, as well as the hemlock, are used by the Indians and Canadian voyagers to sleep upon. In their winter voyages, they scrape the snow into heaps with their snow-shoes, making a kind of 'snow wall' on each side of their lair, then strewing the ground with branches, wrap themselves in their blankets, and thus sleep, when the thermometer is many degrees below zero. In this way, between two Indians, did Captain Thompson sleep, in his unsuccessful attempt to overtake Captain Franklin in his arctic journey."

When one considers the severity of winter in Lower Canada, even without reference to the rapid and extreme heat of summer, it could scarcely be supposed that such luxuriant vegetation could exist in the province as distinguishes it. The fact must be accounted for by the rich alluvial nature of the soil, which has for ages been unmoved, and on which has been accumulating for centuries successive layers of leaves, and other vegetable matter, until a fertilizing manure has covered the earth to a depth of several feet. Just let us see what is said of the strength of growth exhibited by the white pine.

"This tree, called in our English parks the *Weymouth pine*, is the most majestic of all the Canadian pines, and, with the exception of some of this family found in the neighbourhood of the Columbia river, on the north-west coast of America, reported to be 250 feet high, and 50 feet in circumference, towers over all the trees of the forest, being occasionally found of 150 feet in height, and 5 feet in diameter at its base. When growing in open

situations, it is feathered to the ground, but, as generally found in Canadian forests, is little more than an immense stick, with a certain quantity of brush at its head, in about the same proportion as the hair on the tail of an elephant. It is a most universally used and valuable timber, being also the cheapest, and is called in commerce *white pine*, *yellow pine*, or *American pine*; the quality and size vary with soil and situation, and equally so the value, according to the manner in which it is converted or manufactured; that is, as to straightness, size, and the equal, smooth, and parallel cutting of the sides. It is of immense size, of small specific gravity, very free from knots, and easily wrought. These properties, as may be supposed, ensure it an immense consumption, being equally in repute for the largest masts of our men-of-war, and the smallest article of carving, or inside decorations of our houses: it may be called, *par excellence*, the carpenters' and joiners' wood. The Americans use it by preference for ships' decks, as it resists the sun, is not brittle, and will not allow water to run through, being not liable to crack or split. In general, too, it is preferred by them for works under water, or for water courses, or "dalls," as they are called. When properly applied and treated, it is as durable a wood as any other of the pine family, but, when improperly applied and treated, it is very apt to engender dry-rot."

Some of the white pines, as being yellower in color and mellow in quality than others, are particularly in demand for musical instruments. But American pines serve other than these slight and tiny purposes. Were it not for the supply from Canada, government could not procure masts for our large ships of war. They are contracted for as large as thirty inches, that is, ninety-nine feet long, thirty inches cube at fourteen feet from the base, and measuring twelve loads eighteen feet each when dressed. Trees affording such stems are rarely found, and with immense difficulty are they brought down to the rivers. Roads of considerable length are of necessity cut through the woods, for this purpose, from the locality of the tree, to the river, at an enormous expense; even for common timber of merchandise, not one in ten thousand is fit to cut. The establishment of a first rate "Shanty," as it is called, (from the Fr. "*Chantier*,") to cut masts, is a matter of no small magnitude or expense; it must be commenced by the first of October for the next year's supply. The party occupied therein are generally from thirty to fifty men, having as many oxen and nearly as many horses. The provisions and provender for both the men and cattle, fully ample for seven months, has to be forwarded to the establishment from Montreal at an astonishing outlay, consisting of flour, pork, molasses, rum, beer, oats, hay, &c. &c. as well as clothing, blankets, flannel, shoes, boots, axes, chains, saws, &c. The advance altogether for such a Shanty is little short of £2,000. It is from the large requisitions for these Shantys, that the lumbermen are considered the pioneers of improvement; because at two hundred miles' distance from Montreal, the carriage of such an immense material against the currents of the rivers, with rapids and falls to overcome, offers a temptation for agriculturists to follow them as closely as circumstances will admit.

The Canadian oak is not so durable as that of Britain, the fibre not being so compact and strong. The birch tribe are numerous, and the sap, drained in March and April, from all the varieties, makes

excellent vinegar, or a pleasant weak wine may be obtained by boiling and fermentation. The American maple is a beautiful tree in all its grades; that called the *bird's eye*, takes its name from its mottled hue; the *curled maple* is richly shaded in fibres, admits a high polish, and forms the ornamental work so much admired in the American packets. It is from a variety of the maple (*acer saccharinum*), that the celebrated maple sugar is made; the production of which, in Lower Canada, is about 25,000 cwt. annually. The tree is large and shadowy, with richly tinted autumnal foliage, and esteemed as timber for strength, weight, closeness of grain, waving fibre, and susceptibility of polish. The sugar is extracted by evaporation from the sap, which it yields abundantly when the bark and wood is wounded in spring; one tree yielding from a pint to two gallons per day. A plantation of maples is termed a *sugari*, and is justly considered valuable, as the sugar is rich and pleasant to the taste, and sells from 3d. to 6d. per pound.

We might go on and present to our readers many other curious or valuable specimens of the vegetable kingdom, as given by Mr. Martin. For instance we are told that the Nuns of Canada prepare a vegetable plaster which, it is said, never fails to cure inveterate cancer; but the secret of preparation has not been divulged. One of the most remarkable facts spoken of, is that in America, as also in New Holland, and other heretofore untilled countries, whenever the original forest is burnt or cut down, trees of a different species spring up, but seldom any of the sort growing previously to the application of fire. Thus also, on the Malabar coast it is necessary to burn down the Cardamom and other spice plants, before young trees will spring up in their place. In Canada indigenous grasses, not heretofore seen, spring up after the land is cleared of wood, and the banks of the Slave Lake, formerly covered wholly with spruce, fir, and birch, when laid waste by fire, produced subsequently and spontaneously poplar, which had not been before seen. We have only room to add to these curious facts, the general truth, that the whole of creation teems with life, and that too in its most variegated forms.

MAKING OF VINEGAR.

For making malt vinegar the process made use of is very like the first stages of the brewer's operations. The malt is ground, and mashed with hot water. The wort is then cooled on the usual cooler, from which it is transferred to the fermenting tun, where being mixed with yeast it ferments. The fermentation being over, the liquor is transferred to smaller vessels. These are arranged in an apartment kept warm by means of a stove: the temperature is maintained even until the acetous fermentation is complete, and perfect vinegar is formed. This requires several months, more or less, according to the temperature and the strength of the liquid. It would require years to acetify it to the same degree, but that the souring is assisted by introducing into the casks, along with the wort, a quantity of the residuary fruit which has served for making domestic wines, or which is preserved by the vinegar-maker from one process to another in his own factory for this purpose. It is called *rape*; its use is to act as an acetous ferment, and thus inoculate the wash with sourness, it being well impregnated with vinegar, and continually kept so. Occasionally, also, other vegetable substances, impregnated with vine-

gar, are used as acetous ferments. They all abridge the time necessary for acetification, which without them would be considerable; and the process would be more liable to failure.

Another mode of conducting the acetification is to transfer the wort, after it has undergone the vinous fermentation, into casks. The bung-holes of these are left open, and merely covered loosely with tiles. The casks are then exposed to sun and air for a great length of time, until the acetification is perfect. The introduction of stoves has superseded this mode. The stove has greatly abridged the time, and has rendered the process much less liable to failure. In either method of proceeding, as soon as the vinegar has arrived at its greatest degree of sourness, the process should be stopped; for if continued the sourness would gradually diminish, and would at length totally disappear, and give place to putrescency. In order to prevent the occurrence of this injury, the vinegar must be racked off its lees, just as ale or wine would be; for the lees, in any of the three cases, will continue to act on the liquor greatly to its detriment unless removed. With a view of still more effectually removing this injurious matter, as well as for the purpose of rendering the vinegar transparent, a clearing process is adopted, the same in its principle and practice as that made use of by the brewer or wine-maker. Isinglass is dissolved in a small quantity of the vinegar, and the solution is mixed with the remainder. The whole is then allowed to subside; and as soon as it is sufficiently clear it is racked off, and is then fit for sale. Some manufacturers, however, do not use isinglass, but prefer clearing their vinegar by age. They conceive that by spontaneous subsidence they produce a better article for keeping. On an average it may be stated that one barrel of good malt is capable of producing thirty gallons of good house vinegar. The quantity of water used for the mashes should be calculated accordingly.

In the making of malt vinegar, a mixture of raw corn will neither lessen nor deteriorate the product. When raw corn is used, the heat of the water used in mashing must be lower than when malt alone is employed. Weak worts are soured in a shorter time, and at a lower temperature than when the wort is strong. The heat of the mash liquors, and the lengths drawn, are to be the same as for strong porter; but they should be so calculated that no boiling down will be necessary. Hops have been recommended by some makers of vinegar as calculated to conduct the acetifying process to the end without any taint of putrescency; but if the stoving have been rightly managed there will be no taint of this kind, and hops will be but a needless expense. When the relative quantity of water to the grist has been too great, the strength of the wort may be brought up by the addition of sugar. The temperature of the wort when the yeast is added must vary according to the temperature of the weather, as is the case in the brewing process. The heat maintained in the stove should vary with the strength of the wort; if the heat be such in the stove as will insure a temperature of 75° or 80° in the vinegar, it having been made of the saccharine strength already described, it will be sufficient. The length of time required for the maintenance of this temperature in the stove depends on the strength of the wort, and on the manner in which the vinous fermentation had been conducted. If the fermentation had been so managed as not to generate any acidity in the tun, it will require the longer time in the

stove; and this will be an advantage. It is to be kept in mind that vinegar is formed from alcohol in this process: the greater the quantity of alcohol present in the fermented wort, or rather wash, the greater will be the quantity of vinegar produced when the process is finished. This being the case, it is obvious of how much importance it is to conduct the vinous fermentation in such a way as is most conducive to the production of alcohol. But there is a limit; although, when wine and vinous liquors are converted into vinegar, it is the alcohol which suffers the change, we are not to infer from this that the more alcoholic the liquor the better it will be for vinegar. The truth is, that if it be too alcoholic it will not acetify at all; for the presence of much alcohol acts as a counteractor of the acetous fermentation.

The following is the process made use of, on the large scale, for preparing raisin vinegar, an article which sells at a higher price than malt vinegar, it being supposed to be a purer and better-flavored manufacture. Sugar is used as well as raisins to afford the fermentable basis. The fermenting tun is charged in the following manner:—To every hundred gallons of water, one hundred pounds of raisins and the same quantity of sugar are added, both of which are preferred of a bad quality for cheapness. The raisins are not bruised or cut; for they are used in so many subsequent processes that the whole of the soluble matter is eventually extracted from them. The mixture of water, raisins, and sugar is made at such temperature that the resulting degree will be 65° or 70° , according to circumstances. The mixture is then well roused up, and in some hours a fermentation spontaneously arises, without the addition of any yeast; for the raisins contain the natural yeast of the grape, and it is ready to become active when it is presented to the proper substance to act upon. The vinous fermentation then proceeds: the temperature rises more or less as the quantity is very large or moderate, but not at all if the quantity is small. It ought not to rise higher than 85° . The fermentation continues, according to the state of the weather, about three or four days. Meanwhile the liquor, which had marked perhaps 45 on the saccharometer, has now been attenuated to 15 or 10, below which it ought not to fall. The fermentation is then immediately checked by racking off the wash into another tun, where it remains for two or three days. It is then let into cask-shaped vessels, each capable of holding about 300 gallons. These vessels are constructed as follows:—The cask stands on its end: at about two-thirds of its whole height from the ground is placed a false bottom, pierced with holes; and there is a lid which shuts down tolerably close on the top of the cask. All above the false bottom is filled with what is called *rape*, which in general means the residuum of any fruit when the juice is extracted; but in this case is raisins which had served originally for mashing with sugar and water, and which have parted with their saccharine matter. A long line of these casks being arranged close to each other, and each having a layer of rape on its false bottom, they are filled with the wash in the following manner:—The first is filled entirely; the second is filled only to the height of the false bottom; the third is filled entirely; and the fourth only to the false bottom; and so on alternately. This is the arrangement for the first day; but were the liquor left in this state for any

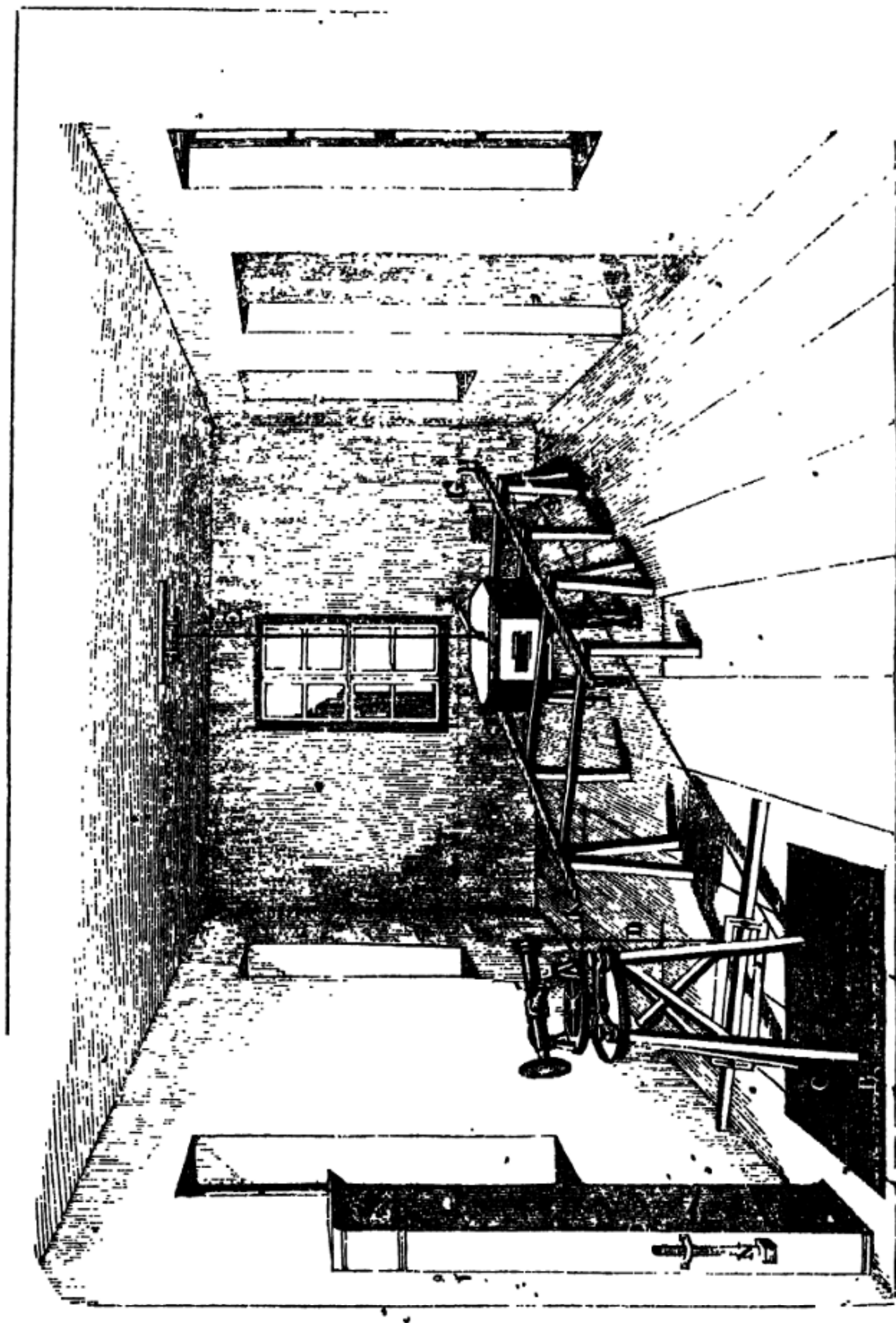
considerable length of time it would become overheated, owing to the inordinate energy of the acetification, and the whole would run into the putrefactive fermentation. To prevent this, a change is made every day. On the second day, liquor is drawn out of the first or full cask until its surface falls as low as the false bottom: what is thus drawn out is poured into the second, which had been only full to the false bottom, but which with this addition is now entirely full. The same change is made in the whole series; and every day the liquor is made to circulate by these means. The apartment in which the series of casks is arranged is warmed by a fire kept constantly burning. The fire-place is a kind of furnace, the flue of which proceeds horizontally through the whole extent of the apartment, or *stove*, as it is called; and having arrived at the end, it turns round over the former, and proceeds back again the whole way until it arrives at the furnace, where it discharges into a vertical flue. Thus the whole heat extricated from the burning fuel is carried through the flue; it passes through the brick work of which it is composed, and warms the air of the apartment. But as brick work is a bad conductor of heat, this plan is less advisable than another which is adopted in other vinegar manufactories. The furnace is so contrived that it heats a metal conduit which opens in the cool air near the mouth of the furnace, and then passes on to the stove-room. The furnace heats the air in the metal conduit; the air being thus rarefied ascends into the stove-room; cool air from without enters, becomes heated, and passes upwards. Thus a continual current is established, which both heats the stove, and ventilates it at the same time, an object of the greatest consequence in preventing any putrid tendency. It is surprising how small a quantity of fuel affords the necessary temperature by this mode of applying it, and how bad a quality of fuel will succeed. A mixture of about equal parts of bad cinders and ashes answer for supplying the furnace, with a little coal occasionally. The proper temperature to be maintained is about 80° , and this must be kept up for about three months, when the vinegar will be sufficiently soured. The vinegar is then to be drawn off, a solution of isinglass is to be well mixed with it, and after due subsidence, the liquor, now perfectly clear and bright, is to be let into casks, which are to be bunged down. The article is then ready for sale.

PROCESS FOR OBTAINING OXYGEN GAS.

BY MR. BALMAN.

A MIXTURE of three parts of bichromate of potash and four parts of common sulphuric acid, placed in a capacious retort, and moderately heated, will yield pure oxygen with a rapidity entirely at the command of the operator.

This process is cheaper than that of heating chlorate of potash; for two parts of bichromate of potash will produce as much oxygen gas as one of chlorate of potash, whilst the latter is nearly three times the price of the former; moreover, the residue of the first is valuable, and may be reconverted into bichromate of potash. It is also a more convenient process than any previously known, since it may be conducted at so low a temperature that a common retort and lamp will liberate a considerable quantity of oxygen.—*Annals of Electricity*.



MAGNETIC OBSERVATORY AT GÖTTINGEN.

ARRANGEMENT OF MAGNETIC OBSERVATIONS.

A LONG quadrangular room, which extends about 11 metres in the direction of the magnetic meridian, is best suited for the reception of magnetic instruments. It is not necessary that the side walls should be parallel with this meridian; they may form an angle with it, as is the case, for instance, at Göttingen, where they are in the direction of the astronomical meridian, which at present forms with the magnetic an angle of $18\frac{1}{2}$ degrees. The room must be well lighted, principally from the east and west, and more particularly at the end where the theodolite or the telescope, together with the scale, are to be placed for observation. The room should be protected from currents of air, for which purpose, a double door, and sometimes even double windows, are necessary; and there must be a solid foundation, upon which a theodolite and clock may be erected. It is also necessary that, from the place of the theodolite telescope, a distant object, the azimuth of which is known or may be accurately determined, may be seen through one of the windows. The floor in the neighbourhood of the instruments, i. e. near the centre of the room, must contain no iron, nor must any object containing that metal be brought near them. It is even desirable that the entire building, even as to its side walls and roof, should contain no iron; but it is unnecessary to be so cautious as to fear placing a clock, or a theodolite with steel pivots, at a distance of from five to six metres from the instrument. The influence of the steel parts, if they are magnetic, may be approximately deduced by calculation, and is found to be much too small to be sensible at those distances. Small pieces of iron outside the room have still less influence. If, however, there were in the neighbourhood large masses of iron, especially very long iron bars, (such as iron railings,) although their influence would be very small, yet it should not be totally neglected. If they are at a distance of a hundred feet from the observatory they offer no important impediment at least if they are fixed. Such a locality is sufficient for measuring the declination and intensity, and also observing their changes. Measurements of the inclination may be performed in the same locality, but not, however, without interrupting the other observations. It therefore appears convenient, when circumstances permit, to assign a separate locality for measurements of the inclination, which may be at no great distance from the first-named room. Where no absolute measurements are made, but only the changes of declination observed at the fixed terms, such a room suffices, even should it contain much iron within and without its walls, provided that all the iron remains unmoved during the observations. The room of the Göttingen magnetic observatory is figured in our cut.

For the purpose of setting up the instrument, a line should be drawn on the floor representing the magnetic meridian, which line must pass nearly through the middle of the room, and terminate at the southern or northern end of it, where a firm foundation, as at C, must be made for the theodolite and clock. When this foundation has been prepared, and the theodolite placed upon it, let a scale be first attached to the stand of the telescope, so that a plumb-line, D, let fall from the object glass of the telescope passes freely before the scale. The scale must be horizontal and at right angles with the magnetic meridian; it must be capable of being

raised or lowered at pleasure, and must be bisected by the magnetic meridian passing through the optical axis of the telescope. Next let fall a plumb-line, E, from the ceiling to the floor, in such manner that the plane of the magnetic meridian passing through this plumb-line may contain the optical axis of the telescope; and when the magnetometer, F, is suspended by the plumb-line, the distances of the reflecting plane of the magnetometer from the scale and from the telescope, may be together equal to the distance of the telescope from a point, G, on the opposite wall, which is to serve as a mark, to which the telescope may be directed. At the point of the ceiling whence the plumb-line is let fall, the suspender of the magnetometer, together with the elevating screw and suspension thread, must be fixed. Let a weight be provisionally attached to the thread suspended from the elevating screw, in the manner of a plumb-line; adjust the suspender on the ceiling until the thread coincides with the plumb-line, making the length of the suspender parallel to the north or south wall of the room. After this, measure the height of the suspender, of the telescope, and of the scale from the ground. From the first height, subtract half the sum of the two latter, and form a thread of parallel fibres of raw silk, whose length is equal to this difference, and which is sufficiently strong to carry the magnetometer, and 2 lbs. of additional weight. The upper extremity of this thread is to be fastened to the screw, and the lower to the stirrup, in which the magnet bar is placed. A wide box is placed under the magnet bar, at the bottom of which are two cushions, upon which the magnet bar would fall, in case the raw silk fibres should break, without endangering the mirror attached to the front extremity of the magnet bar. After these preparations the more accurate measurements may be commenced. These are:—

1. To place the magnetic axis of the magnet in a horizontal direction, and the mirror perpendicular to it; or to measure the small angle which the axis of the mirror forms with the magnetic axis.
2. When the magnet is in its mean direction to bring the force of torsion of the thread to zero, or to measure the small remaining torsion.
3. To determine the ratio of the moment of torsion of the thread, and the magnetic moment of the bar, in a deflection.
4. To ascertain by measurement the place for the mark on the wall opposite to the telescope.

The apparatus is then ready for measurements of the declination. These consist:—

1. In the measurement of the azimuth of the mark.
 2. In determining the values of the parts of the scale.
 3. In observing the vibrations and elongations.
- For the measurements of intensity measuring scales are required, by which the position of the deflecting bar is determined. These measuring scales, H I and J K, may be laid horizontally and parallel to the magnetic meridian, on both sides of the box in which the magnetometer is included, in such manner that lines connecting the corresponding points of the two measuring scales shall be horizontal, and at right angles with the magnetic meridian. The scales should be placed at such height that the deflecting bar placed on them stand at an equal height with the vibrating bar. When this is not the case, the vertical distance between the deflecting bar situated on the measuring scales and the vibrating bar must be measured. The measuring

scales must be 15 or 16 feet in length, and should project an equal distance north and south beyond the magnetometer. If the width of the room allow, it is advantageous to add a third measuring scale horizontally, and at right angles with the two former. It may pass under the box of the magnetometer in such a manner that it would be met by a plumb-line let fall from the middle, between the centres of suspension and gravity of the vibrating bar. The measuring scales must be so arranged as to allow of displacing them longitudinally, in order to dispose them in such manner, that the deflecting bar, situated at corresponding points, in front and in rear, may produce the same amount of deviation. After these preparations, the measurement of the intensity consists,

1. In determining the moment of inertia of the deflecting bar.

2. In measuring the time of vibration of the deflecting bar.

3. In measuring the deflection of a suspended auxiliary bar produced by the deflecting bar, at two different distances of the latter, in a south and north, or east and west direction from the magnetometer.

THE OYSTER. *OSTREA EDULIS*.

History.—In England, the oyster fisheries are chiefly carried on at Colchester, in Essex, celebrated for its green oysters, at Faversham and Milton, in Kent, and in the Isle of Wight. They are also fished for in the Swales of the Medway, in the Tenby on the coast of Wales, and near Liverpool, as well as around Portsmouth, and in many of the creeks of the southern coast. The best are found at Purfleet, the worst near Liverpool. They are very plentifully but partially distributed, and are found to extend further north on the western than on the eastern side of the island. In Scotland they also abound, but appear likewise to prefer the north-eastern to the north-western coast. While they are everywhere plentiful and highly flavored, from the Clyde to the Zetland, Orkney, and Western Islands, it does not appear that they breed higher on the other side than in the Firth of Forth. Those on the western shores are however comparatively little used, and with the exception of a few sent from Loch Fartbert to Greenock, they are consumed by the natives on the spot. Those of the eastern coast, on the contrary, are carried to Newcastle-upon-Tyne, Hull, and London, and have been exported in large quantities to Holland. The best are procured near Preston Pans, Port Seaton, and the Isle of Inchkeith, in Musselburgh Bay, Firth of Forth; and vessels from Milton, Lee, and other parts of England come to dredge for them, and carrying them away afterwards fatten them for the markets. Those from Preston Pans are known by the name of *Pandoors*, as being found at the door of, or near the pans, and from the quantity of fresh water are the fattest and best flavored. In Wales, Milford Haven is celebrated for its oysters.

Oysters are found on most parts of the French coast, but they are most plentiful on those of Bretagne and Normandy. The most extensive fishery is that which is carried on at Granville, in the bay of which, and for six leagues to the northward, they abound. The fishermen bring them to the town, and dispose of them to women, who after having fattened them, dispose of them, either pickled or in the shell. Paris, Dieppe, and Rouen, are chiefly supplied from this place, for which purpose boats

are continually arriving from other parts. The oysters from Rochelle and Bordeaux, and generally from the coast of Bretagne, are however by far the most esteemed; being fatter and more highly flavored, owing to the quantity of fresh water there running into the ocean. Here they are *greened* in the same manner as in England, and require about the same time to come to perfection. They are all to be met with in Paris, but those from Normandy in the greatest number. The appetite for shell fish of all sorts, which seems peculiar to the natives of the southern provinces of Italy, is such as to appear exaggerated to a foreigner, accustomed to consider but a few of them as eatable. So great, however, is it, that at Taranto, the government draws a revenue of twenty-four thousand ducats annually from the shell fishery alone. In the Mare Piccolo, on which this place is situated, the spawn of the oyster is received on large conical earthen pans, secured at equal distances by ropes tied to them, and sunk in different parts of the bay. Their appearance is equally singular and beautiful; the vessel becomes entirely hidden by the shells, when the whole assumes the form of one solid, but irregular mass of rock-work. The young oysters being rubbed off are scattered through various parts of the bay, and when sufficiently grown are collected by means of iron rakes.

Natural habits.—The European oyster is smaller, thinner, and more rounded than the American, while the lower valve is less concave or vaulted; it is not beaked, and the fish, compared with the size of the shell, is smaller, and of a different flavor; there are, besides, various other differences, and their habits are so very dissimilar that there can be no doubt at all of their being distinct species. The European oyster is found only adhering to rocks and stones, or occasionally to very strong clayey bottoms, and should these be washed away the oyster beds perish. The fish is viviparous, and the young produced with a perfectly-formed shell. They are, when first emitted, quite transparent, and they swim with great quickness, by means of a membrane extending out of the shell. So small are they in this state that Van Leeuwenhoek computes that one hundred and twenty in a row would extend an inch, and consequently a globular body, whose diameter is an inch, would, if they were round, be equal in size to one million seven hundred and twenty-eight thousand of them. The vulgar opinion, and that on which the restraining laws have been framed is, that the period of spawning is May, at which time the young, or spat, is found adhering to the rocks. But as the young, as described above, are found in the parents perfectly formed and alive in the month of August, this is most probably the period of parturition, though it be not till May that they become fixed or sufficiently grown to be seen by the common observer. At this time they are about the size of a sixpence, and comparatively hard and firm, and have been well compared to a drop of candle grease in water. In two, or at farthest three years, they are fit for the table. The age to which it attains is probably great, but after having arrived at its full size, the valves are thickened, instead of being increased in length or breadth. From May to July both the male and female oyster are said to be sick, and are in thin and poor condition, but by the end of August they have again recovered, are fat, and in season. The sexes are distinguished by the fishermen by the color of the fringe; that of the male being black, or dark colored—that of the female

white. Sand is prejudicial to them—a mixture of fresh water advantageous. The shell, according to Mr. Hatcher, is formed of carbonate of lime, and a great proportion of animal gluten, but more intimately mixed, and not lying in regular layers, as in the perlicious shells. The oyster frequently contains shining intestinal worms, or animalcules, which may be seen by opening the shell in the dark. A most destructive animal in an oyster bed is the sea-star, (*Asterias glacialis*, Linn.) which clasps its rays round the shell, and perseveres till it has sucked out the inhabitant. Another enemy is said to be the muscle, (*Mytilus edulis*, Linn.)

Fishing.—In both England and France the season for fishing for the oyster is restricted by law. In this country the time allowed for collecting the spawn from the sea is May, when the dredgers may take all they can procure, but after that month they are liable to be convicted of felony if they disturb it, and are only allowed to take such oysters as are the size of half-a-crown. The spawn, or spat, as it is technically called, is dredged up, and if not too small, they separate it from the shells and stones to which it is adhering, and these they are obliged again to throw into the water to prevent the beds being destroyed. The spat is thrown into creeks or into shallow water on the shores, to increase in size and fatten, and in such situations is considered private property. At Preston Pans the oysters are not bedded, but are entirely procured from the sea, and in dredging those which are too small are thrown back again. The season begins on the 1st of September, and lasts till April. The dredgers make use of a peculiar kind of net, which is very strong, and fastened to three spikes of iron; this they drag along the bottom of the sea, and thus force the oysters into it; each boat requires five men, and they dredge in water from four to fifteen fathoms deep. The green oysters are all procured at, or in the neighbourhood of Colchester. When they wish to give them this color they throw them into pits, dug about three feet deep in the salt marshes, which are overflowed only at spring tides, and to which they have sluices to let out the salt water till it be about one and a half feet deep. These pits become green, and communicate their color to the fish in four or five days, although they commonly let them continue there six weeks or two months, in which time they will become a dark green. The color has recently been ascertained to arise from confervæ, and other marine vegetable matter, decayed by the heat of the sun, on which the animal feeds. A very common and very mistaken opinion exists, especially among foreigners, that not only those, but all English oysters are impregnated with copper, which they get from feeding off copper banks; such we believe would be quite as injurious to the animal itself as it could be to us, and the fancy can only have arisen from the strong flavor peculiar to this fish. Green oysters are comparatively little esteemed in the present day.

Use.—The great value of this animal is for diet. The shell was at one time supposed to possess peculiar medicinal properties, but analysis has shown that the only advantage animal carbonates have over those of the mineral kingdom arises from their containing no metallic or foreign substance. The inhabitants of the shores of Hindoostan did, two centuries since, and perhaps still may, use it in the same manner. The fish is recommended by the doctors whose great nourishment and easy digestion are required, the valuable quality being the quantity

of gluten it contains. In the north-eastern parts of England old houses may be seen with their tops and gable ends ornamented with these shells, only the inside being exposed; a custom which is safe, we know not with what truth, to have been introduced from Holland. In some parts of Scotland the shells are used as manure, and found very excellent and stimulating; in other places they are burned as lime.

WATCH ESCAPEMENTS.

BY MR. DENT.

(Continued from page 219, and concluded.)

The duplex escapement is so named from its escapement-wheel having both cogs and long teeth; (see drawing beneath;) the cogs A being placed

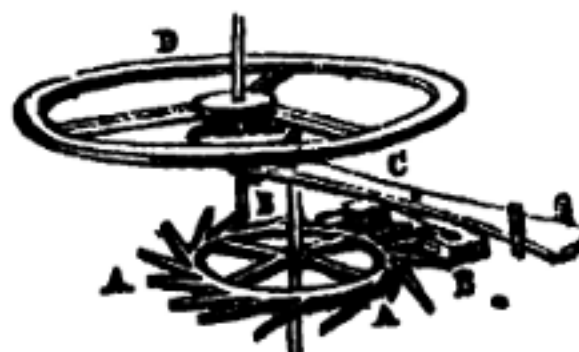


upright near the centre, while the long teeth B are in the same plane as the wheel; whence arises a double action: C is the brass-balance. This is of English invention. Watches having the duplex escapement are, perhaps, to be ranked next to the chronometer, particularly as regards the length of time which they will continue to perform without cleaning, or requiring a fresh application of oil. The escapement is shown in the wood-cut, as seen upon opening the watch.

To the eligibility of this movement there are, it must be acknowledged, some drawbacks. It is of delicate construction, and if not made and put together by a workman of superior talent, the watch is liable to stop in the pocket. If it meet with a fall, the injury done may cost from £4 to £5 to repair. Under these circumstances, no gentleman, unless he previously determine to bestow some care on its protection from injury, should carry a duplex watch about his person, when intending to take any violent exercise, such as hunting, fencing, and gymnastic recreations.

The duplex movement is not at all calculated for a lady's watch, because, if worn suspended from the side by a hook, the pendulous motion, which it would probably be subjected to, might injure the escapement, and it would, in consequence, be liable to stop.

The lever escapement is so named from there being a lever added to the action of the escape wheel. This escapement, which is also of English invention, possesses numerous advantages over all other escapements used for watches; and, indeed, so perfect was it considered many years since that chronometers constructed on this principle were tried at the Royal Observatory for public reward, and are still so made when required for particular service.

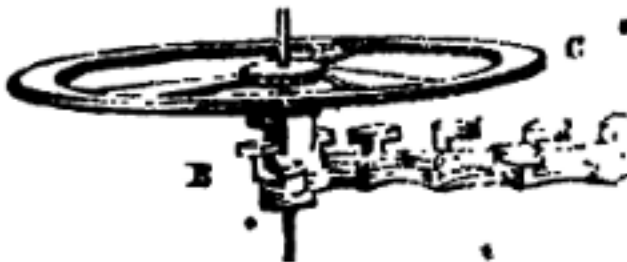


Such has been the attention bestowed on the improvement of this escapement, that it has become the best for all ordinary use. Its advantages may be summed up in these particulars:—strength, moderate price, capability of bearing much external motion without derangement, and small expense of reparation if it meet with injury. An examination of the wood-cut shows that it is a strong escapement.

A is the escape-wheel, which gives motion to the ruby pallets, B and B'. C is the lever which gives impulse to the balance D. Beside the strength of this construction, there is another great advantage attending it,—that it admits so much subdivision of labour in the manufacture. This has occasioned so great a reduction in charges that any one may now purchase a plain lever watch for the same price that was paid for a vertical watch some years since. Thus the expense of the lever escapement is not great, while its principle is unobjectionable.

I have said that no other escapement is so well calculated to bear violent exercise on the part of the wearer; and to this recommendation must be added that no portion of the escapement can be broken by accident but the balance-axis, which can be repaired for a few shillings; while the duplex escapement might not admit of reparation under a charge of from £2 to £3.

The horizontal escapement, so called from the escape-wheel acting in the horizontal position, (see the drawing. A the escape-wheel. B the cylinder. C



the brass balance.) This was the escapement which succeeded next in manufacture to the vertical, and is also of English invention. The Swiss, who, from this escapement being most suitable to flat watches, have devoted their attention to its improvement, must, in the manufacture of it, be fairly owned to surpass us. The English watch, as has been stated already, admits more scope, and the introduction of escapements possessing recommendations adapted to the circumstances, the habits, and pursuits of the wearer. The detached lever escapement has in consequence almost wholly superseded the horizontal one in England.

CARVING.

THE art of carving is one of great antiquity. In early times it was ranked as a species of sculpture; since idols, figures of gods, heroes, &c., were cut in wood as well as in stone. The durable nature of the latter material, however, has led to the abandonment of figures of wood in most cases.

The use of carving, as a means of producing representations of fruit, flowers, and other ornamental subjects, has been continued from very early ages to our own time. The choirs of cathedrals, the ancient mansions of some of our nobility, and many other places, afford evidence of the extent to which carving was carried in by-gone days. There was an eminent carver named Gibbons, who, in the reigns of Charles the Second and James the Second, executed many specimens of carving which still remain as proofs of his ability; some of these specimens are at Windsor Castle.

The great pitch of excellence to which the art of painting arrived in the sixteenth and seventeenth centuries, and the number of pictures which were produced at that period, must have given a great impetus to the business of the carver; for nearly all the frames made for those pictures were, as we have before observed, carved previously to being gilt. The elaborate richness of the old frames, which are now being imitated by the composition ornament maker, shows that the art had attained considerable perfection. At a later period, the frames were made of broad deep mouldings, which had carved leaves, trellis-work, &c., laid upon them in different parts. This gradually led the way to the introduction of composition ornaments, which have now, to a large extent, superseded the use of carved ornaments. But still, for very large frames, the latter are much used, both on account of their superior lightness and boldness, and because the ornaments can be made to any style and form which the purchaser may require; whereas composition ornaments must depend for their patterns upon the moulds which the ornament maker may happen to possess.

A person engaged in carving ought to possess some taste for drawing or modelling, or both. The ease and elegance of the foliage and flowers which the carver has to imitate cannot be produced by one who does not possess a natural taste for drawing, and, we may add, some knowledge of botany; since it very frequently happens that the fruit, flowers, and foliage, upon fancy work generally, whether it be the lace veil of a lady, or the ornaments of a looking glass, are but poor imitations of nature. It excites regret to see good workmanship thrown away, as it often is, upon bad design, which a little knowledge of botany might convert into a tasteful production, simply by making it natural. A carpenter can make his mouldings and his sashes, and a joiner can make his frames, without requiring any particular exercise of taste, because he has a rule, a square, and compasses, to guide him in every part of his work; but a carver can derive but little assistance from such guides; for if his taste cannot tell him how to make a leaf of foliage appear light and easy, all the rules and compasses in the world would not be sufficient for that purpose.

When a piece of carved ornament is to be afterwards gilt, a soft and cheap wood, such as American pine, is generally employed; but when the veins of the wood are intended to be seen, without either paint or gold, such wood as box, oak, pear-tree, maple, lime-tree, &c., is employed, according to the purposes to which the ornament is to be applied. The soft wood, then, which is used by the carver for ornaments afterwards to be gilt, is sawed out of planks of various thicknesses, according to circumstances, and pieces are glued one upon another at those parts which are to be most raised or prominent. This is an easier plan than that of cutting the ornament out of a solid block of wood, equally thick in every part.

The carver is, in most cases, furnished with a pattern of the ornament which he is required to imitate, which is drawn upon paper. When he has selected a plank of the proper thickness, he lays the drawing down on the plank, having previously cut out the paper to the exact outline of the drawing. He then marks this outline on the wood, according to the drawing; and any holes which are to be cut entirely through the wood are marked in the same manner. He then, with a bow-saw, which is par-

ticularly adapted for sawing in curved directions, cuts out the plank according to the pencil marks, and also cuts the holes. This gives him the requisite outline, and he has next to fill up details. For this purpose, he screws the piece of wood, (or glues it, if thin,) down to his bench, by means of a screw which passes from beneath through the bench, and into the lower surface of the wood; by which means the wood is held firm, without making screw or nail holes in the upper surface which is to be carved.

Having now sketched the details of his ornament on the piece of wood, he proceeds to cut the wood into the proper form by means of very sharp tools, the greater part of which are gouges of various sizes and shapes. A gouge is a sort of chisel, with one surface round and the other hollow; and a tool of this form is much more useful to the carver than a flat chisel, since the sharp corners of the latter would be apt to dig into the parts of the wood which were not required to be cut. A carver has seldom to produce a perfectly-flat surface, so that gouges are used for almost every kind of ornament; they are, therefore, made of different widths and different degrees of curvature of surface. Some of them are bent at the end, in order to work out the details of the deep parts of an ornament, which could not be effected by a straight tool. The whole of these tools must be kept very sharp, or the carver would make but little progress at his work. The sharpening is performed by rubbing the edge obliquely on a soft stone moistened with sweet oil, and requires some care to avoid altering the shape of the edge. When a piece of ornament is carved, and the proper effect produced on a front view, it is necessary to chamfer or undercut the edges, to give an appearance of lightness. To effect this, the ornament is held in the left hand, and the wood is cut away in the proper places by the tool held in the right hand. The foregoing details apply to pieces of ornament, such as those which were placed on the corners of glass frames a few years ago. But when a frame is carved nearly all over a somewhat different process is necessary. The joiner must precede the carver, and make the ground-work on which the latter is to be employed; he must, in fact, make the frame. This is a part of the carving trade which has undergone much fluctuation. In the early part of the last century such frames were very common; in the latter part of the same century, and the beginning of the present, they were comparatively rare; at the present day their use has again revived. In preparing such frames as these, and before the carver commences his work, the joiner, in putting the frame together, must regulate the thickness of the wood at different parts by the nature of the ornaments which are to be situated at those parts; in order that the carver may have to cut away as little as possible of the wood.

Much tact is necessary in regulating the motion of the carving tools, with reference to the direction of the grain of wood; a piece of wood would be presently split were it not for precaution in this matter. No written description will suffice to show how to attain success in this particular; since, like the details of carving generally, personal inspection and personal instruction will alone give a clear idea on such matters. Notwithstanding the extent to which composition ornaments are used on frames, the lightness and durability of carved frames, and the facility with which any required pattern may be produced, will probably always prevent them from getting quite into disuse.

The chair carver, and those who carve for cabinet makers, &c., are seldom the same as those who serve the gilder. They have to use harder wood and sharper tools, and have to finish up their work more neatly, because any roughnesses in ornaments that are to be gilt may be easily removed by the processes which the gilder afterwards employs; but no such process is employed by the cabinet-maker on his ornaments, so that they must be made smoother in the first instance. All carvers, however, are accustomed to use bent files and rasps to smooth the surface of their ornaments, after the cutting has been performed.

TO ASCERTAIN THE PURITY OF COAL GAS, &c.

THE offensive odour which proceeds from the burning of coal gas, when it is not completely freed from sulphuretted hydrogen, was formerly urged as a strong objection to its use. This, however, has been effectually obviated by the improvements introduced into the methods of purifying the gas before it is delivered from the works. Sulphuretted hydrogen may be discovered by its smell; but there are other means, very simple in their application, of detecting it, and of ascertaining the purity of the gas; that which is most common consists in exposing it to a contact with a solution of acetate of lead. For instance: if the burner be unscrewed, a bent tube, having one of its ends fitted with a corresponding screw, or a cap of leather to slip tightly over the end of the pipe, may be thus attached to it; then by immersing the other end of the tube in a phial, containing a few grains of acetate of lead, dissolved in distilled water, and by turning the stop-cock, the gas of course will pass into the bottle. If any portion of sulphuretted hydrogen is combined with the coal gas, the mixture will become dusky, and a black precipitate will be produced, but if the gas should be perfectly pure, the solution will retain its white and milky appearance.

The infusion of litmus is another test of the presence of sulphuretted hydrogen in coal gas. The color of this infusion is usually a dark purplish blue; and if sulphuretted hydrogen be dissolved in water, with which it readily unites, by adding a small quantity of it to the infusion of litmus, it changes its color to red. If the gas contains carbonic acid, the addition of an equal portion of lime-water will detect it, by its producing a precipitate which will dissolve with effervescence on adding a few drops of muriatic acid.

Silver and mercury also indicate the presence of sulphuretted hydrogen gas. If a little mercury be put into a bottle, with water containing sulphuretted hydrogen gas, a black film soon covers the surface of the metal; and if the bottle be shaken, a blackish powder is separated. When this kind of gas comes into contact with the bright surface of silver, it very soon becomes tarnished.

For the above purposes, another mode of operating is frequently practised, which is, that of filling a bladder with the gas by means of a stop-cock fastened to its neck, and having an appropriate screw to attach it to the place of the burner. The bladder should be previously moistened to render it flaccid, and, when it is filled with the gas, by affixing a bent tube to the stop-cock, the trials may be readily made in the way which may be most convenient to the operator.

ON FLOUR AND BREAD.

THE following judicious experiments and observations on flour and bread were delivered by Dr. Irving to the Committee of the House of Commons, appointed to consider of the methods practised in making flour from wheat, &c., which we think are worthy of being known at this time.

"To grind wheat into flour with the greatest advantage, the millstone should make about sixty revolutions in a minute; if faster, the stones acquire too much heat, and give a burnt taste to the meal; if slower, a part of it adheres firmly to the bran or husk, and cannot be separated in the bolting.

"Flour, when kept some time, evaporates a part of its moisture, becomes less adhesive and clammy, loses somewhat of its agreeable taste, and imbibes a greater portion of water in the making of it into dough; the bread of it appears smoother in the cutting, whiter in the grain, dries sooner, and becomes more crumbly, than the bread of new flour. These reasons induce the baker to prefer old flour to new in the making of bread.

"The yeast of porter does not raise bread so perfectly as that produced from small beer; besides, it is bitter to the taste; the baker, therefore, in London, instead of using a sufficient quantity of yeast for the leavening of his bread, mixes only a small portion of it with flour and water, made to the consistence of a syrup, called *sponge*, which, when fermented, is added to the flour; and, being worked up together into dough, the whole mass is suffered to ferment.

"This method, however, of leavening the dough, is by no means so good as that in which yeast only is used; as it gives the bread a sour taste, frequently perceptible in that of London. I find by experiment three pounds and a half of flour, kept a year in a dry place, requires two pounds of water to make it into dough, and loses in the baking into bread ten ounces; but from the variable age, dryness, and quality of the flour, with the indeterminate degrees of kneading and baking, it is impossible to ascertain the exact proportion of water in all cases; nor is any uniform proportion ever observed by the bakers.

"Flour made from heated or damaged corn does not thoroughly mix with water, so as to form a perfect dough, unless a small portion of alum be added. In this case, the baker is induced to use it; as he may be likewise, when the water with which he makes the dough is very muddy: alum having the property of purifying it. I find, however, by the experiment of dissolving the salt from bread by water, and adding to the solution an alkali (which would discover the earth of alum by precipitation) that the bakers in London very seldom use alum, but substitute hard pump water, with an extraordinary quantity of common salt; which, in some measure, answers their purpose in the working of damaged flour.

"Flour or bread, freed of its salt, being burnt in a crucible, leaves behind only a very small portion of earth; but if chalk, lime, whitening, bone ash, or any calcareous substance, be mixed with either, these foreign ingredients will remain unconsumed in the crucible, and the quantity may be perfectly ascertained. The mixture of these ingredients with flour or bread may also be discovered, by adding spirit of salt well diluted with water; and their quantity known by precipitation with a fixed alkali. The following experiments were made with a view of ascertaining these facts:—

"*First.* One pound of fine flour, burnt in a crucible, left behind twenty-eight grains of earth; of which nineteen were sandy matter; the remainder soluble in an acid.

"*Secondly.* One pound of bread of a quartern loaf, freed of its salt by water, and treated in the same manner, gave forty-three grains, of which twenty-nine were sandy matter; the rest soluble by an acid.

"*Thirdly.* One pound of bread added to spirit of salt, sufficiently diluted with distilled water, gave scarce any precipitation of earth by adding a fixed alkali.

"From these and other chemical trials, several times repeated with flour and bread procured in many parts of London and Westminster, the result was nearly the same, except that coarse flour and bread contained a few grains more of earthy matter. It evidently appears, therefore, that no frauds were practised in the above samples.

"The defects of the London bread seem to be owing to the following causes:—1st. The use of old flour, in preference to new, which gives the bread a less savoury taste. 2nd. The employing *sponge*, instead of yeast, which generally gives a sour, unpalatable taste to the bread; and 3rd. Not kneading it sufficiently, but, in place of that labour, using too great a quantity of water, which makes the bread heavy and unpleasant."

MANUFACTURE OF TORTOISESHELL.

THE animal which produces this beautiful substance is a marine tortoise, called the *Testudo imbricata*, or hawksbill turtle. Its Latin name is derived from the mode in which the scales on its back are placed, overlapping one another like the tiles on the roof of a house. In this circumstance, it seems to differ from almost all others of its genus; the scales of other tortoises, both those which are land animals and those which inhabit water, either salt or fresh, generally adhering to each other by their edges, like a piece of inlaid work. These plates, in all the tortoises, cover the bony arch of the back formed by the ribs and spine united into one immovable convexity by flat bones stretching from rib to rib, and uniting insensibly with the spine. The hawksbill turtle is a native of the torrid zone, and is found in the Indian seas as far as New Zealand, on the coast of Africa, on that of New Granada, in South America, and in many parts of the West Indies, especially on the Mosquito shore and the promontory of Yucatan. Its usual length is about three feet long, and weighing five or six hundred pounds.

The number of plates produced by each tortoise is thirteen; namely, five along the back, and a row of four others on each side: there are also twenty-five, much smaller ones, forming the margin of the shell. The size and thickness of the plates depend on the magnitude and age of the animal, a fresh layer being produced every year; and at the margin of the large plates may be seen distinctly the edges of the layers as they thin off in succession. Sometimes, however, large plates are met with, so thin as to consist, apparently, of only a single layer. The cause of this anomaly is not known; but some of the dealers in this article have an opinion that these thin plates are the produce of full-grown tortoises that have been stripped of their plates the year before, either purposely or by accident.

The plates are separated by placing the arch of the shell (all the other parts having been removed)

over a fire, which soon causes them to start from the bone, by the help of a slender knife. The price of rough tortoiseshell depends on its quality, that is, on its thickness, and the vividness and distinctness of its colors. The present price for fine shell is about three guineas a pound. Not unfrequently the plates are considerably injured by barnacles, limpets, and other shell-fish, which fix themselves on the animal while alive, and prevent the growth of the tortoiseshell on that part which they occupy. Sometimes one or more of the plates will be of a plain yellow color; and such are in great request among the Spanish ladies, who will give twelve or fourteen dollars for a comb of plain tortoiseshell, while a similar one of the mottled kind will not sell for more than six dollars. The belly-plates of the tortoise are also yellow, and sometimes clear enough to be made use of.

The general mode of manufacturing tortoiseshell is the same as that already described when treating of horn, p. 205. It is softened by boiling in water; but mere water takes away much of the color: an addition of common salt prevents this injury; but if too strong a brine is used the shell will be very brittle. Two or more pieces of tortoiseshell may be joined by laying their scraped or thinned edges together, and then pressing them between hot iron. If, however, the heat is too great, the colors are much deepened so as to become almost black, as is the case with moulded snuff-boxes; for tortoiseshell, being less fusible than horn, cannot be made soft enough to be moulded without some injury to the color. Accordingly the manufacturers, at least in England, never attempt to produce tortoiseshell combs with ornamental open work by means of dies, but in the following manner:—

A paper being pasted over the tortoiseshell, the pattern is drawn on the paper, and is then cut out by means of drills and fine saws: the paper is then removed by steeping in water, and the surface of the pattern is finished by the graver. In making small side-combs, it is found worth while, in order to save a costly material, to employ a machine consisting of a cutter working straight up and down, and of a bed (on which the shell is laid), to which is given a motion advancing by alternate inclination, first to one side and then to the other. By this means the teeth of two combs are cut at the same time, those of the one occupying the intervals of the other. Such combs are called *pared*, the saw not being used upon them; and are often made of fine stained horn instead of tortoiseshell. Tortoiseshell is also used for inlaying tables, cabinets, and other ornamental articles, a metallic foil being placed below it to give lustre and color. This employment of it appears to be coming at present considerably into fashion.

Among the Romans of the Augustan age, this taste was not so much a fashion as a fury. The frames of the couches on which they reclined at table were covered with the largest and most beautiful plates that could be procured of tortoiseshell; and it was employed for various other purposes: but we are not aware that it was ever used by them as a material for combs. It was brought by Indian and Arabian traders from the islands in the Indian Sea to Adulis, in Abyssinia, together with ivory, rhinoceroses' horns, and hippopotamuses' hides. Here it was purchased by Egyptian merchants, was transmitted to Alexandria, and thence passed to

Rome and the other great cities of the empire. For modern uses, thick tortoiseshell is more valuable in proportion than thin; but among the Romans where it was used only for inlaying, veneers were cut out of it. This art was the invention of one Corvilius Pollio, a man, as Pliny says, of singular sagacity in all things that ministered to prodigal luxury.

PREPARATION OF RAZOR STROPS.

MR. THOMPSON, a surgeons' instrument maker, has found that the best razor strops are thus made:—Glue a piece of common calf-skin leather on a slip of wood, and when dry rub it with a piece of French chalk,—that called by mineralists *steatite*; then, with a piece of the finest lamp black lead that can be procured; and thus proceed, using the French chalk and black lead alternately, one after the other, until a sufficient coat or bed is formed on the leather. The other or the rougher side of the strop may be covered with great advantage by candle snuff, laid on with a little grease.

GLAZING PAPER.

To the Editor

SIR.—Observing in your answers to correspondents, that you wished to obtain a method of glazing paper, I take the liberty of forwarding the following description of the process, as performed in a paper manufactory.

Almost all the printing and colored papers being now made by machinery, and being made very fast, it is important that the glazing process should be performed with the same expedition as the paper is made. To this end there are generally three cast-iron rollers or cylinders of great weight; in the manufactory in which I am engaged, the top roll weighs 13 cwt., the bottom 25 cwt., and a small one, which runs on the side of the largest, 5 cwt.; these rollers are placed at the end of the drying machine, and the paper being only partially dried, is passed between the aforementioned rolls, which being heated by steam, complete the drying process, and impart to the paper a beautiful gloss, which may be increased by screws placed on the top roller.

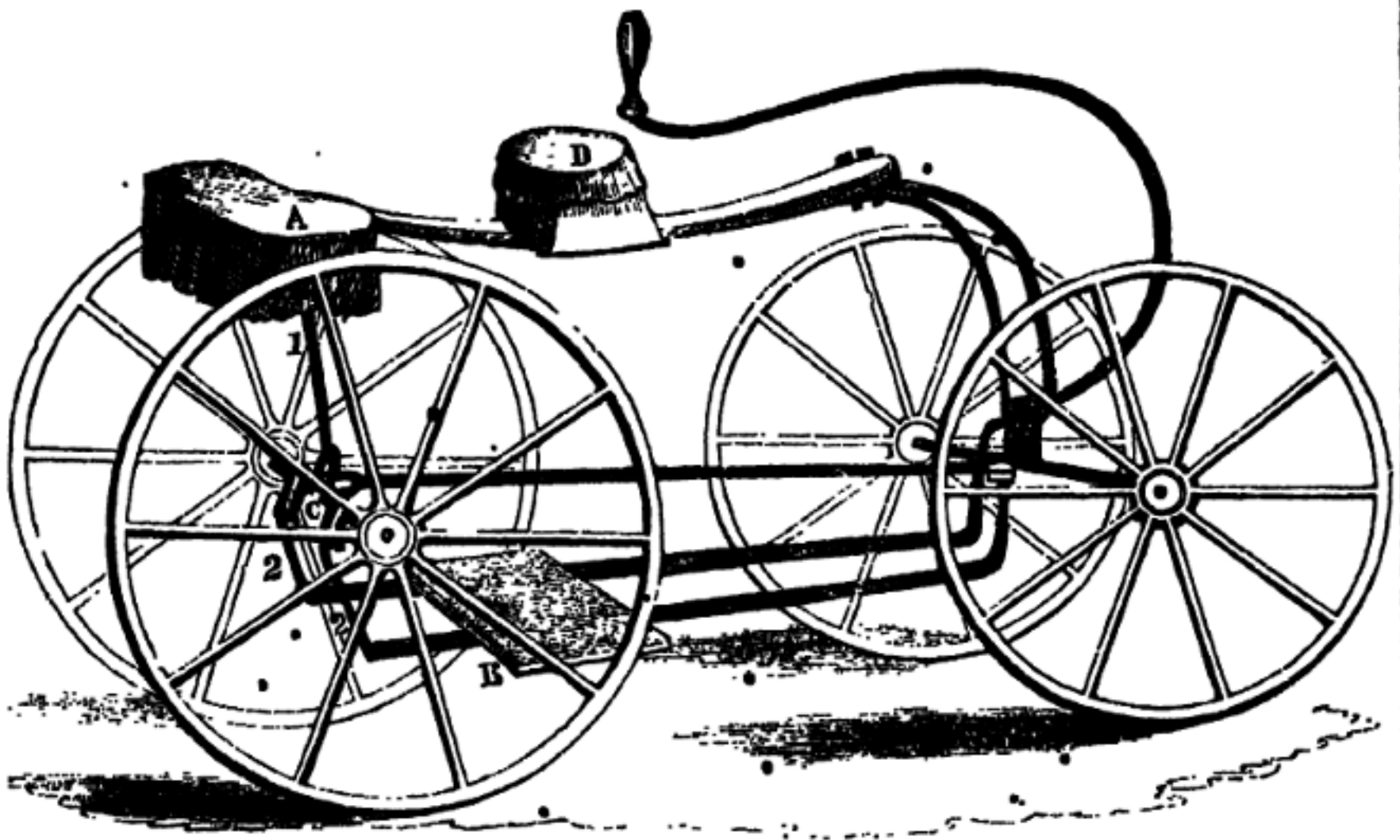
Writing papers are either “glazed” or “boarded” as it is called, that which is glazed is effected by placing each sheet between polished copper or zinc plates, which are then passed between solid iron rollers, one, two, or three, according to the degree of gloss required. Paper which is “boarded,” is placed sheet by sheet between “glazed boards”; it is then pressed in a powerful press for about 12 or 14 hours. There is another process called “hot-pressing,” which is merely placing heated iron plates between the “wads” or parcels of glaze-boards when placed in the press in lieu of boards of wood. The iron plates are made very hot in an oven.

I do not know if this is the sort of description you wished, but it is an exact description of the various processes as performed in a manufactory.

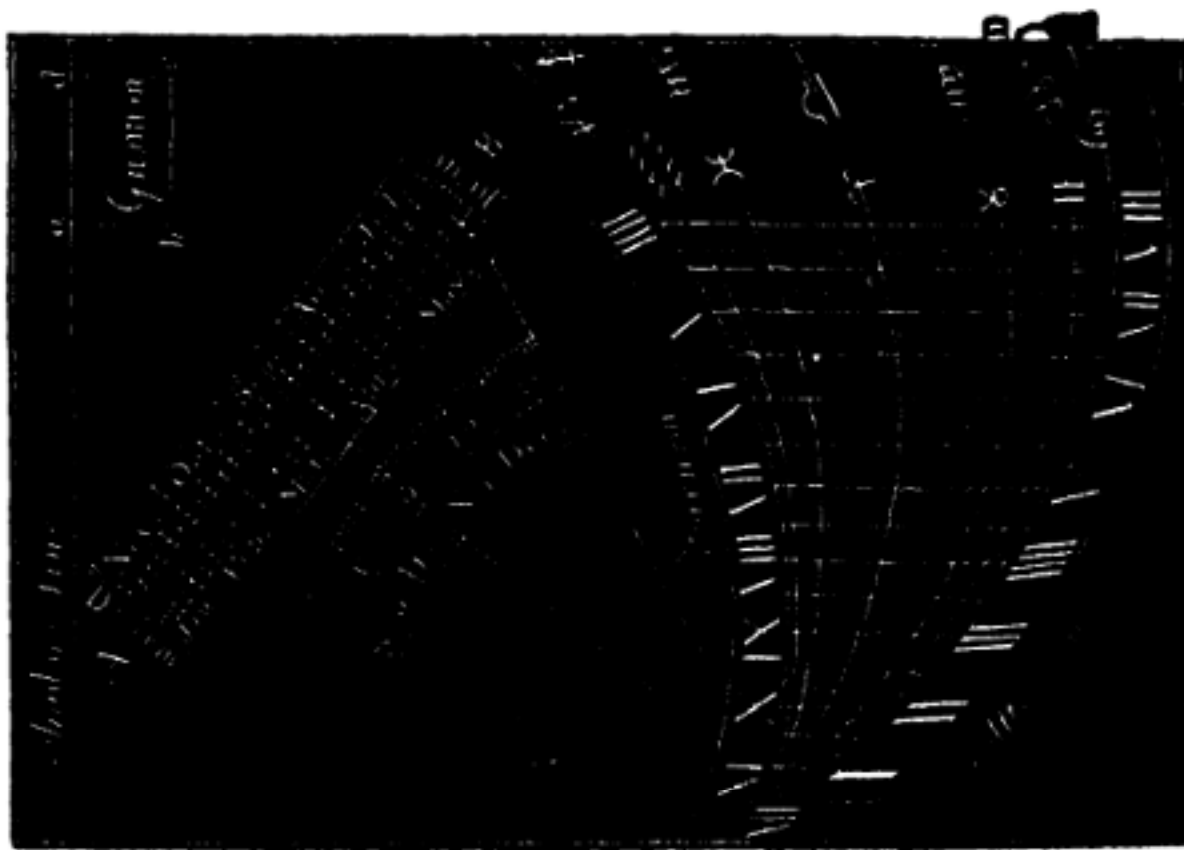
Maldstone, Oct. 1842.

A PAPER-MAKER.

[We rather think that our former correspondent desired to be informed of the manner in which ornamental and colored papers and enamelled cards are glazed, and which is evidently a different process. We shall be obliged if our present correspondent will communicate this further information.—ED.]



THE HOMOMOTIVE MACHINE.



PORTABLE SUN-DIAL.

HOMOMOTIVE CARRIAGE.

(To the Editor.)

SIR.—I herewith send you a rough drawing of the Homomotive Carriage, of which I am the present proprietor, though not the inventor. The simplicity of its construction and machinery requires but little explanation; it will be readily perceived, that the motion of the rider must be that produced by a horse in full trot, the seat A, and foot-board B, alternating in their rise and fall with the revolutions of the cranked axle C, to which they are respectively attached by connecting rods 1 and 2, of a suitable length, for an agreeable sitting position, which is at all times preserved. D is a small box with cushion for the arms to rest on while guiding; the diameter of the wheels is 2½ feet. On a level road, five miles per hour may be accomplished; its speed down hill might be regulated by a drag,—but I have checked it at full speed, by merely standing up and holding by the back of the seat with one hand. In ascending hills, it is necessary to push or draw it; but so easily is this accomplished, that a terrier dog has been quite sufficient to run up with it, furnishing an agreeable change in the exercise of a short walk. Bodily infirmity has prevented my availing myself of its advantages, on account of which, and being about to remove, I shall dispose of it. Two others, on the same principle, have lately made frequent journeys of 50 and 60 miles per day, *without fatigue* to the riders. I truly consider this simple application of the cranked axle worked by the weight of the rider, as the attainment of the long-sought desideratum for self-propulsion, and that it will be very generally adopted I have no doubt. As a substitute for horse exercise, the advantages are obvious; even ladies who may object to mount a horse, might have it adapted for their use in private grounds, as it requires neither skill nor labour to work it.

H. M. C.

Bath Herald Office, Oct. 14, 1842.

PORTABLE SUN-DIAL.

IN fig. 2 we have a representation of a portable dial, which may be easily drawn on a card and carried in a pocket book. The lines *a d*, *d b*, and *b c* of the gnomon, must be cut quite through the card; and as the end of *a b* of the gnomon is raised occasionally above the plane of the dial, it turns upon the uncut line *c d*, as on a hinge. The dotted line *A B* must penetrate through the card, and the thread *c* must pass through that line, and have a knot tied behind to preserve it from being easily drawn out. Upon the other end of this thread is a small plummet *D*, and in the middle of it, a small bead for pointing out the hour of the day.

To rectify this dial, set the thread in the slit right against the day of the month, and stretch the thread from the day of the month over the angular point where the curve lines meet at XII; then shift the bead to that point on the thread, and the dial will be correct. To find the hour of the day, raise the gnomon, (no matter how much or how little) and hold the edge of the dial next the gnomon towards the sun, so as the uppermost edge of the gnomon may just cover the *shadow line*; and the bead then playing freely on the face of the dial, by the weight of the plummet, will show the time of the day amongst the hour lines, as it may be forenoon or afternoon. To find the time of sunrising and setting, move the thread among the hour lines, until it either covers some one of them, or lies parallel

between any two; and then it will cut the time of sunrising among the forenoon hours, or of sunsetting among the afternoon hours, for that day of the year to which the thread is set in the scale of months.

To find the sun's declination, stretch the thread from the day of the month over the angular point at XII, and it will cut the sun's declination, as it is north or south, for that day, the arched scale of north and south declination. To find on what day the sun enters the signs; when the bead, as above rectified, moves along any of the curved lines which have the signs of the zodiac marked upon them, the sun enters those signs on the days pointed out by the thread in the scale of months.

LIQUORS FROM THE COCOA-NUT.

Toddy, in some countries known as palm wine, is obtained from the cocoa-nut tree in the following manner:—

Two months after the blossoming of the cocoa-nut tree, the capsulated flower is tied, in three different places, with strips of the white leaves of young branches, which are tougher than the old ones, in order to prevent its expansion:—the flower is then cut a little transversely from the top, and beaten with the handle of a toddy knife, or a short baton of ebony or iron wood; which process having been continued, morning and evening, for five or six days successively, the under part of the sheath of the flower is taken off, so as to permit of its being gradually bent; which being done, the toddy-drawer, for the purpose of keeping it in that position, attaches it to some neighbouring branch. After a farther period of five days, an earthen chatty, (earthen vessel) or calabash (the fruit of the *cucurbita lagenaria*, L. hollowed and dried,) is hung to the flower, so as to receive every drop that exudes. This delicious liquid is the *toddy*, which the Singalese denominate *ra*, and the Hindo-Portuguese *souira*. The tree, when appropriated to this purpose, yields no fruit, the nourishment which would have perfected it being drawn from the flower, which yields a supply morning and evening. The toddy-drawer cuts the flower a little every day.

Europeans prefer toddy before sun-rise, when it is a cool, delicious, and particularly wholesome beverage, acting as a gentle aperient; but the natives prefer it after fermentation has commenced (which takes place in about three hours more or less); in that state, bread-bakers use it as yeast, for which it is an admirable succedaneum; and the bread made with it, remarkably light and good. Toddy is seldom used by Europeans during the rains, unless it be by those *wet souls*, to whom Claret and Madeira are not sufficiently stimulating, and who, to use a nautical phrase, "would drink the sea dry!" Soldiers consider the addition of gunpowder and capsicums to toddy—a mixture they designate by the term "*blaze*"—an improvement.

The lower classes of Singalese often intoxicate themselves with fermented toddy, during the hottest parts of the day, when they may be seen near the toddy shops or *boutiques*, as they are styled in the government licenses, squatted on a log of wood, or on the bottom of an inverted canoe, in the full enjoyment of—that heaven upon earth to them—idleness and inebriety together.

Arrack, of a quality superior to that known as Batavia Rack, which is entirely manufactured from rice, is distilled in Ceylon from the cocoa-nut toddy, after it has undergone fermentation and become

quite sour, and not from sweet toddy, as some Europeans have erroneously asserted. One hundred gallons of toddy produce by distillation, (the process of which in Ceylon is of a most simple nature,) 25 of arrack, or rach, by which term it is more generally known in England and elsewhere, and by the Singalese, *Polwakéré*. This spirit, when new, is considered injurious to the constitution; but after it has been kept some years, it becomes one of the wholesomest that can be made use of.

Sweet toddy and jaggery.—A clean and dry calabash or earthen chatty, being suspended under the flower of the cocoa-nut tree, having first had a few pieces of the bark of the Allghas (*Hellenia Allughas* L.) put into it, a supply of sweet toddy will be obtained mornings and evenings; but particular care is required that the vessels be regularly changed, and that none are employed unless they have been well cleaned and dried. Eight gillons of sweet toddy, boiled over a slow fire, yield two gallons of a very luscious liquid, called honey, or sugar-water; which quantity being again boiled, a species of coarse brown sugar, called *jaggery*, which in is general use by the natives, is the product. The jaggery is formed into round cakes, of the size and shape of the common bun sold by our English pastry-cooks, and dried in the smoke of the huts; and, in order to preserve it free from humidity, each cake of jaggery is tied up in pieces of dried or dead Banana leaf, *Musa Paradisiaca*, L. separately, and kept where smoke has free access to it, until required for the family use or for the market. Jaggery is exported to various parts of India.

Toddy vinegar.—Vinegar is made in the following simple manner from the toddy of the cocoa-nut tree. The required quantity of toddy is collected in dry weather, put into jars, and well covered. After a month, the contents are strained, and replaced in the same jars, with the addition of a little Chili pepper, commonly called Bird pepper, *Capsicum frutescens*, a small piece of Ghorkah, fruit of the *cambogia gutta*, (the red sort is to be preferred, being the most acid,) and of the pod of the horse-radish tree, *hyperanthera moringa*. At the expiration of a month or five weeks it becomes very excellent vinegar, nearly equal to European for pickles, fumigation, and other purposes of general use.

SHIP BUILDING

(Resumed from page 221.)

THERE are various rules for sparring ships, all founded upon their length and breadth, which are the main elements of stability. It may be sufficient to name one simple rule for the length of the main-mast, this being the prime mover:—Add the length at the lead water-line to the main breadth, and take the half sum as the length of the mast. The top-mast may be three-fifths of the lower mast, the main-yard seven-eighths of the same, and so on upwards. The fore-mast may equal seven-eighths of the main, with upper masts and yards in proportion. The mizzen-mast, if stepped on the keelson, is five-sixths of the main-mast. The best rules on this subject are, perhaps, found in tables accurately prepared, in which the lengths of the masts are given in fractions of the ship's breadth, and those of the yards in fractions of the length. For the rest, it will be, in most cases, necessary to modify any given rule, in all instances, with immediate reference to the particular model of the ship, and to the uses for which she is destined. A vessel of war will have spars to

spread sail to the full extent of stability, while a merchantman will be sparred with reference to the limited force of her crew. As for the disputed advantages of long or short lower-masts, we agree entirely with Sir Cloudealy Shovel, who says, with equal wit and wisdom, "I mightily esteem short lower-masts; for, the shorter they are, the longer they will stand." With long top-masts you may make up an equal or even greater surface of canvass, far more advantageously spread, and more manageable, while it is procured at less expense, and with less weight aloft. It would be, moreover, an advantageous improvement in merchant ships, not sparred to the extent of their capacity, to make the fore and main-masts, in all cases, of equal dimensions. With improved appearance they would have all the respective spars and sails, except the courses, answering equally well for both masts. This would enable them to go to sea with fewer spare ones, or to derive more advantage from the usual number. In small ships, all the spars are of single sticks of pine timber, which, for equal contents, are always stronger; but, for ships above six or seven hundred tons, it is impossible to procure single trees sufficiently large; and then it becomes necessary to resort to made masts, (so called,) which are of oak and pine, very artificially put together, and bound with about hoops of iron.

The spars of a ship are not abandoned to their own unsupported strength, but are sustained by what is called the standing rigging. This consists, for the bow-sprit, of gunning and bob-stays, confining it down to the stem and shrouds, which sustain the immense lateral pressure which it endures when on a wind. The jib-boom and flying jib-boom are, in like manner, supported by means of martingales and guys. The fore-mast is supported by three or four pairs of shrouds on either side, which set up to the channels, and by two stays led forward to the bow-sprit. The fore-top mast is supported by shrouds setting up in the top, back-stays descending to the channels, and stays leading to the bow-sprit end. The top-gallant and royal-masts have also their shrouds setting up through the cross-trees, their back-stays descending to the channels, and their stays leading to the jib and flying-jib booms. In like manner are the main and mizzen-masts supported, except that the main-stays set up on deck beside the heel of the bow-sprit, the main-top mast stays at the head of the fore-mast, the main-top gallant stay to the fore-top mast head, and main-royal stay to the fore-top-gallant mast head. The mizzen-stay also sets up beside the main-mast, and the same in ascending. The running rigging consists of the tacks and sheets that serve to spread the sails, the halyards, traces, lifts, clew-lines, and all other ropes used in making, taking in, or manœuvring the sails.

The sails of a ship are square sails bent to the yards, and fore and aft sails traversing on stays or bent to gaffs. Let us describe an entire suit, beginning forward:—On the extremity of the bow-sprit is the flying-jib, a three-cornered sail, which goes from the end of its boom upward along its stay, leading to the fore-top-gallant mast head, and confined to the stay by rings of wood or iron, called hanks. It is hoisted by means of halyards, hauled down by a down-haul; and, when up, is trimmed to hold the wind by a sheet leading to the fore-castle. The jib, which leads from its boom to the fore-top mast head, is of similar form, and so is the fore-top mast stay sail, running from the bow-sprit end

towards the mast head. On the fore mast we have the fore-sail, bent to the fore yard, and spread at the foot by means of tacks and sheets; above it, the fore-top sail, bent to the top-sail yard, by means of which it is hoisted aloft, while its lower corners are spread to the extremities of the fore-yard; next the top-gallant sail, bent to its yard, and sheeting home to the top-sail yard; and so with the royal and sky sail. All these sails are turned at pleasure, to be presented to the wind, by means of braces attached to their yard-arm, and leading to the main-mast. The main-mast is furnished with a similar suit of sails, somewhat larger; the mizzen, also, though smaller than either; instead of a square-sail on the lower mast it has a gaff-sail, hoisting up and down abaft the mast. Some ships have similar gaff-sails on the fore and main-masts, which are found of great use in gales of wind, as a substitute for storm stay-sails. Most carry, also, light stay-sails between the masts; but they are very troublesome, and worse than useless. Studding-sails, or wings, as they are better called by the Spaniards, spread without the square sails when going large, and are very useful. The perfection of equipping a ship with spars, rigging, and sails, consists in so disposing them, that, in a whole-sail breeze, the centre of effort of all the sails will be in the same line with the ship's centre of rotation; or that the efforts of the forward and after sails to turn the ship will be so exactly balanced as not to require any continued assistance from the rudder in either direction; for this, while it impedes her progress, does not leave the entire force of the rudder disposable, when necessary to turn. Of the two evils, however, seamen have more patience with a ship disposed to approach the wind, than with one needing the continued action of the helm to keep her from falling off. The French helmsmen well characterize these two qualities by calling a vessel which has the first ardent, the latter cowardly. Like, however, cool courage, between impetuosity and cowardice, a midship helm is still the golden mean.

Our ship is now completely equipped, and ready to receive cargo. Those articles with which a ship may be filled full are stowed with a single view to economy of space. Some, as cotton, require ballast; others, as staves, or sugar and fluids, require none. When the articles are heavy and light, the heavier are placed nearest the bottom, to increase the ship's stability. When, however, all are heavy, there may be danger of making a ship too stiff; so that, not being balanced, she will roll violently, and, perchance, risk the fracture of a mast, or even spring a leak. To obviate this danger, the cargo should be raised: if iron, some should be stowed between decks; if coal or salt it may be heaped up in the centre, taking care to secure it against shifting, should the ship be knocked down by a sea or squall. Heavy articles should never be placed towards the extremities, lest they promote pitching. In all cases, care must be taken to preserve the trim of the ship—that just proportion between her draught forward and aft, which the estimate of the builder, or, when a voyage has been made, experience itself, has determined to be most favorable to rapid sailing.

Our ship is now ready for sea, and it only remains for us briefly to explain the manner in which she is propelled and governed, and made obedient to her crew. There is no difficulty in conceiving how a ship may be made to move before the wind through a quiescent fluid like the sea. Let us suppose one at rest in a perfect calm, and equally pressed on

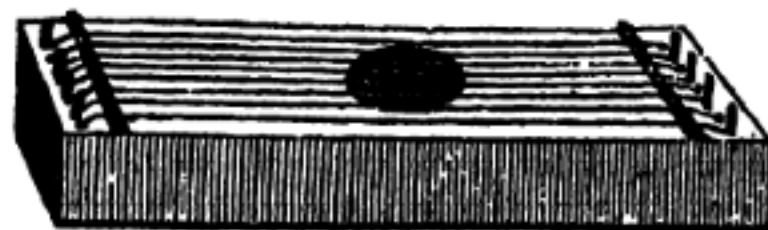
every side by the gravitating action of the same fluid—she is maintained in equilibrio. But, by and by, a wind rising behind her, strikes her sails perpendicularly, and exerts a pressure in a single direction. As, however, the sails are attached to spars, and these in turn to the ship, it is evident that they cannot obey the impulse independently of the ship, but that all must move in unison; and the ship, being before pressed by the water equally, and maintained in quiescence, requires but a slight additional pressure in any direction to destroy her equilibrium. This pressure is abundantly supplied by the air of our atmosphere; for, though little more than a thousandth part the density of the sea, it may receive a velocity enabling it to strike the sails with its particles in such quick succession as to force the ship forward with great rapidity, and, if the resistance of the water check her escape before it, may even act with sufficient power to blow away the strongest sails, or even tear the masts out.

And are we not justified in expressing our admiration at this great achievement of man—the production of this wonderful machine—the most complicated, most perfect, sublimest of all the works of art? If it be well said that man is the noblest work of God, it may with equal truth be asserted that the ship is the noblest work of man. It were a vain task to attempt enumerating the various geometrical problems involved in her design, or the multiplied mechanical principles combined in her construction. Let us only, forgetting all we know, endeavour for a moment to realize the immeasurable distance and difficulties between the trees growing in the forest, the iron and copper buried deep in the bowels of the earth, the hemp waving in the fields, the tar scaled up in its timber, and the actual achievement of the sailing ship? Yet a very short time—a single month—suffices to transform these rude productions into the magnificent machine, which, notwithstanding its mountain form, obeys each command of the mariner; goes from the wind, towards it, halts, or redoubles its velocity, obedient to his voice; in which he launches boldly forth amid the horrors of a troubled ocean; braves them successfully, conducted by the inspirations of a sublime philosophy; attains the most distant shores; accomplishes his purpose, and returns, enriched, enlightened and triumphant, to his home.

We shall conclude this subject with one other paper.

THE ÆOLEAN HARP.

THIS is an instrument the tones of which are so beautiful, the manufacture so easy, and the cost so little, that it is not surprising that it should be a very great favorite where known; yet so unwilling are persons in general to attempt the manufacture of a musical instrument, from the idea that such is necessarily difficult, that the Æolean harp is but little known. We will endeavour to give some plain directions for its manufacture and management. The following cut shows the appearance of the harp when complete:—



It is to be observed that its tones are produced by a current of air passing through any long crevice, as for example the space left underneath a window sash when a little lifted up; this will render plain the instructions and observations which follow.

Form.—It is essential that the length of the harp exactly fit within the frame of the open window; for should it be longer than the transverse aperture, it cannot be brought immediately under the perpendicular plane of the sash, so as to insure the sweep of air in contact with the strings. If it be shorter, much effect will be lost by part of the current passing between the ends and the uprights. But the latter evil is the most easily remedied, because a sliding piece may work on the front, facing each end, and be projected forth, as the deficiency in length may require, so as to block up the horizontal passage of the air, equal to the depth of the instrument. It is not uncommon to make up the defect in length by stuffing paper or linen in between the ends of the instrument and the window frame, but this is an absurd practice, for it muffles the harp by diminishing its elasticity. And here it should be remarked that not any part of the instrument should come into contact with inelastic matter; consequently, it is injurious to cover its bottom with baize, as is frequently done. The depth of the harp should never be less than $3\frac{1}{2}$ inches, nor exceed 5. This depth to be regulated by the length, for the longer the instrument the deeper must it be. The breadth should not exceed 5 inches, for if made broader, the air will act on the middle strings only, unless there be such a parallel plane to confine the sweep of current as we shall hereafter allude to. The length, as before said, should always be exactly that of the width of the window aperture, which, in the largest, seldom equals $4\frac{1}{2}$ feet.

Materials.—The more elastic the better; therefore, if of wood, it should be similar to that of a violin, both in quality and thickness, the bottom excepted, which should be stronger, as a base for bearing the stress of the joined pieces, and the contractile draught of the chords. The breadth of the bridges, which should be of ivory, or very hard wood, may vary from half an inch in the shortest harps, to three quarters in the longest.

Another point, essential to be borne in mind is, that the ultimate effect will be much governed by the degree of elasticity in all parts of the harp; therefore, the wood must not only be perfect in its texture, but also thoroughly seasoned and dry; or the relative states of atmospherical humidity will produce variable powers. The wood, then, after being perfectly dried, should be varnished with hard varnish on both sides, before the parts are joined together, and again on the outside when constructed. For want of attention to this matter alone, many of the harps sold in the shops are very defective.

There should be a block of beech-wood inserted within each extreme end of the box, for the screws and pegs to work in. They should each be about an inch wide, and of equal length and depth with the width and depth of the box; and they must be fixed perfectly firm to its ends. The pegs and screws should always be of metal, that is, the common harpsichord ones; half of each being fixed in each end, so that the traction of the strings be in opposite directions.

Every Æolian harp should have, besides its common chords, or strings, a fundamental, or bass one, of that kind called bass fiddle-string. The others should be the common violin catgut strings,

and perfect in their quality; that is, transparent, firm, even throughout their lengths, and all as nearly equal in thickness as can be selected. Previous to using these latter, they should be wiped dry, a little warmed, and then well rosined to prevent the effect of a moist atmosphere. When the harp is laid aside, the strings should be relaxed; for the common practice of putting the instrument aside with all its strings in a state of tension is dangerous to the harp. It may be warped by their contraction, if the atmosphere become moist, and the strings be not water-proof; or the strings themselves may fly.

With respect to the best method of stringing, where the window aperture is moderate (three feet or under) in length, probably it may be best to carry the strings of equal length, and as long as the instrument will admit, so as to allow convenient space to work the pegs and screws at each extremity. If the harp much exceeds 3 feet, it will be better to use the graduating than equal lengths. Suppose the harp to a little exceed 4 feet, the bass string must be 48 inches, the next common string of similar length; then the common ones should run 36, 24, 18, 12, 8, 4, or some analogous extents. This number of strings is ample for the largest instrument; for when they are too abundant, the undulating air excites rather an aggregation of tones than a due succession, wherein the variety and melody are individually developed to our distinct perception. Indeed, one single string properly stretched will afford all the varied tones of sound, and sometimes an apparent combination; but the effect is transient, and, in order to sustain a continued succession, there must be several strings exposed to the vibrating impulse of the air.

The Tuning.—First stretch the bass string to any pitch you may prefer; as to that of low G, on the flute gamut; and it is best to always retain one standard, taken from any instrument at command. Having this key-note, the remainder may be merely mechanical, the ear not being required, for the eye is fully competent. Our readers, not knowing the fact, may be informed, that if, of two strings in unison, one be vibrated, the other will instantly and spontaneously vibrate also; but if not in unison, the second will remain quiescent. So, several strings nearly adjacent, some being in unison, the others not, if one of the former be vibrated, all those in unison will vibrate; but the latter, though intermediate, alternate, or however relatively placed, will be motionless. And if one out of unison be vibrated, all the remainder will be inactive. In tuning, then, we have nothing more to do than to gradually increase the tension, until the eye can perceive the chord to vibrate fully when the key-string be sounded. But this is not the best of all methods; it is that hitherto used, only having all the strings tuned alike. The following is far superior, as eliciting the fullest powers of the instrument:—Take the bass string as the standard pitch, then extend every alternate string into an octave above the bass, and let all the intermediate ones bear unison with the bass. The effect will be sensibly improved. But should the harp be short, and the length of its strings, of course, limited within diminished oscillation, the higher notes would be apt to run into a shrill scream; to obviate which, the original pitch of the key-string must be proportionally lower, leaving a latitude of play for the higher vibrations, and modifying the influence of a too sudden or too rapid breeze. Suppose there be eight strings, including the bass, the second and fourth from it must be carried into

superior octaves, and the first, fifth, and seventh into unison with the bass. It is obvious that this harp must be rather long; it should be between 3 and 4 feet, to admit of oscillatory scope for the octaves above and below the bass.

Hitherto we have spoken of the harp as commonly constructed with the bass string on the outside of the plane of strings; but having tried, we would urge the placing of the bass in the middle, and having an equal number of common strings on each side of it. There must necessarily be an odd number of strings, and the most convenient plan will be three common ones on each side, with the bass in the middle, making seven in all, or four common ones on each side, making nine. When octaves above and below are required in this form, they should always be on alternate strings, so as to avoid a similarity of tension in contiguous ones; therefore, they must not all be of similar character on the same side; and it is of consequence that, be the octaves placed how they may, some of them should be in unison with the bass. If they all were carried into superior or inferior octaves, the effect would not be nearly so full, the tones so rich, or the cadences so complete. The specific advantages of this form are, that, without complicating the instrument, there arises a variety of accordance in the swells, and it seems also to adapt itself better to the varying intensity of aerial undulation. As to the degree of tension, it is scarcely possible to lay down any specific rule, whereby an amateur can govern his practice; for so many circumstances may influence the operation of the harp, under any given intensity of tension in the strings, as to render it impracticable to meet their separate or combined effect, by instructions that could be detailed within a moderate compass. This point, however, is in some degree met by our remarks respecting the stringing; because, if we take the bass at a certain and known gamut pitch, and give all the other strings their due concords and octaves, we have almost all that is wanted. It must be understood, that although the harp may be well strung and tuned when set to play, yet it may soon cease to issue forth its enchanting tones; or they may not succeed each other so as to sustain a succession of melody, or may not form the cadences with effect; and all this because a change may have taken place in the condition of the strings, or in the strength of the aerial undulations. For if they be subject to be acted upon by the moisture or dryness of the atmosphere, and to that add the heat of the sun, a very few minutes will suffice to throw the best-tuned instrument into discordance. Therefore, as before enjoined, the catgut strings must be well resined. On the other hand, if the wind be too strong for the tension of the strings, the aerial impulses will strike in such rapid succession as to terminate each oscillation before it can complete a distinctly prolonged tone, and so produce a screaming sound, or prevent sound altogether. Now, as we cannot calculate on a particular force of impulse, nor devise any varying intensity of tension, to meet the fluctuating strength of undulation, we must endeavour to control the current itself, so as to adapt it to the existing condition of the instrument. To this purpose we must elevate the sash, and thereby diminish the pressure of the air on the plane of the strings, and close the door of the apartment, as well as open as many of the windows on that side of the house as we can command. We may also remove the harp a little within or without the perpendicular plane of the sash. If all these

means fail, the bass string must be slackened, and all the others be brought into a renewed tuning. This is all that can be done; and it may be added that, be the harp strung how it may, it will seldom play well in a strong current. In a calm atmosphere we can usually act with a better effect; for the harp pours forth its finest tones in a current barely perceptible. But if art be necessary to obtain even this slight power of impulse, the sash must be first lowered a little, the door of the apartment and the windows on the opposite aspect of the house be thrown open, while all those on the same side of the house should be closed. By these means we shall turn the stream of draught through the aperture occupied by the harp; or should they really fail, the only remaining resource will be in slightly increasing the tension of the strings, provided they were previously lax.

A simple and successful means to augment the sweep of the aerial current over the plane of strings, consists in placing a board, by screw, under the sash, so that it shall form a plane parallel with the upper surface of the harp. This in some degree resembles the superior plane of the harp, and which is a board screwed to the harp itself, (as shown annexed,) when



fitted for the open air, and was indeed suggested by it; but mine is broader, the breadth being three times that of the harp, and is an excellent aid when the window current is weak. The harps for the open air, as usually constructed, have their practical limits, as well as for those for window apertures; for their dimensions should never much exceed 4 feet, nor 6 inches in width, with 5 in depth. The number of strings may be the same as already recommended for the others, and if thrown into the graduating form so much the better. Catgut strings cannot bear continued extension to a sufficient degree, if they exceed 4, or, at the utmost, $4\frac{1}{2}$ feet; for they will speedily lose their concords. They should bear upper and lower octaves, with unison strings, and have the bass in the middle. The plane that is placed over them should be moveable, with reference both to its perpendicular elevation and angular bearing with the plane of the strings, so that the aerial current may be as governable as possible.

AQUATIC FIREWORKS.

We gave in Vol. II, a general and original account of the manufacture of the ordinary kinds of those fireworks commonly fired upon the land. Those which sport in the water are no less esteemed, particularly water rockets. We shall therefore endeavour to explain the best and easiest method of making them and other interesting aquatic fireworks.

Water rockets may be made from 4 oz. to 2 lbs.; but, if larger, are too heavy; so that it will be difficult to make them keep above water without a cork float, which must be tied to the neck of the case; but the rockets will not dive so well with as without floats. Cases for these are made in the same manner and proportion as sky rockets, only a

little thicker of paper. When you fill those which are drove solid, put in first a ladle-full of slow fire, then two of the proper charge, and on that one or two ladles of sinking charge; then the proper charge, then the sinking charge again, and so on, till you have filled the case within 3 diameters; then drive on the composition one ladle-full of clay, through which make a small hole to the charge; then fill the case, within half a diameter, with corn powder, on which turn down two or three rounds of the case in the inside; then pinch and tie the end very tight, having filled your rockets, (according to the above directions) dip their ends in melted rosin, or sealing wax, or else secure them well with grease. When you fire these rockets, throw in 6 or 8 at a time; but, if you would have them all sink, or swim, at the same time, you must drive them with an equal quantity of composition, and fire them all together.

To make pipes of communication, which may be used under water.—Pipes for this purpose must be a little thicker of paper than those for land. Having rolled a sufficient number of pipes, and kept them till dry, wash them over with drying oil, and set them to dry; but when you oil them, leave about $1\frac{1}{2}$ inch at each end dry, for joints; if they were oiled all over, when you come to join them, the paste would not stick where the paper is greasy: after the leaders are joined, and the paste dry, oil the joints. These pipes will lie many hours under water, without receiving any damage.

Horizontal wheels for the water.—First get a large wooden bowl without a handle; then have an octagon wheel made of a flat board, 18 inches diameter, so that the length of each side will be near 7 inches; in all the sides cut a groove for the cases to lie in. This wheel being made, nail it on the top of the bowl; then take eight four-ounce cases, filled with a proper charge, each about 6 inches in length. Now, to clothe the wheel with these cases, get some whitish-brown paper, and cut it into slips 4 or 5 inches broad, and 7 or 8 long; these slips being pasted all over on one side, take one of the cases, and roll one of the slips of paper about $1\frac{1}{2}$ inch on its end, so that there will remain about $2\frac{1}{2}$ inches of the paper hollow from the end of the case; this case tie on one of the sides of the wheel, near the corners of which must be holes bored, through which you put the packthread to tie the cases; having tied on the first case at the neck and end, put a little meal powder in the hollow paper; then paste a slip of paper on the end of another case, the head of which put into the hollow paper on the first, allowing a sufficient distance from the tail of one to the head of the other, for the pasted paper to bend without tearing; the second case tie on as you did the first, and so on with the rest, except the last, which must be closed at the end, unless it is to communicate to anything on top of the wheel; such as fire-pumps or brilliant fires, fixed in holes, cut in the wheel, and fired by the last or second case, as the fancy directs; six, eight, or any number, may be placed on the top of the wheel, so that they are not too heavy for the bowl. Before you tie on the cases, cut the upper part of all their ends, except the last, a little shelving, that the fire from one may play over the other, without being obstructed by the case. Wheel cases have no clay drove in their ends, nor pinched, but are always left open, only the last, or those which are not to lead fire, which must be well secured.

Water mines.—For these mines you must have a bowl, with a wheel on it, made in the same man-

ner as the water wheel, only in its middle must be a hole, of the same diameter you design to have the mine. These mines are tin pots, with strong bottoms, and a little more than two diameters in length. Your mine must be fixed in the hole in the wheel, with its bottom resting on the bowl; then loaded with serpents, crackers, stars, small water rockets, &c., in the same manner as pots of aligrettes; but in their centre fix a case of Chinese fire, or a small gerbe, which must be lighted at the beginning of the last case on the wheel. These wheels are to be clothed as usual.

Fire globes for the water.—Bowls for water globes must be very large, and the wheels on them of a decagon form. On each side of which nail a piece of wood, 4 inches long, and on the outside of each piece cut a groove, wide enough to receive about $\frac{1}{2}$ of the thickness of a 4 oz. case. These pieces of wood must be nailed in the middle of each face of the wheel, and fixed in an oblique direction, so that the fire from the cases may incline upwards: the wheel being thus prepared, tie in each groove a 4 oz. case, filled with a grey charge—then carry a leader from the tail of one case to the mouth of the other. Globes for these wheels are made of two tin hoops, with their edges outwards, fixed one within the other, at right angles. The diameter of these hoops must be somewhat less than that of the wheel. Having made a globe, drive in the centre of a wheel an iron spindle, which must stand perpendicular, and its length 4 or 6 inches more than the diameter of the globe.

This spindle serves for an axis, on which the globe is fixed, which, when done, must stand 4 or 6 inches from the wheel. Round one side of each hoop must be soldered little bits of tin, $2\frac{1}{2}$ inches distance from each other, which pieces must be 2 inches in length each, and only fastened at one end, the other ends being left loose to turn round the small port fires, and hold them on; these port fires must be made of such a length as will last out the cases on the wheel. You are to observe that there need not be any port fires at the bottom of the globe, within 4 inches of the spindle; for, if there were, they would have no effect, but only burn the wheel. All the port fires must be placed perpendicular from the centre of the globe, with their mouths outwards; and must all be clothed with leaders, so as all to take fire with the second case of the wheel, which cases must burn two at a time, one opposite the other. When two cases of a wheel begin together, two will end together; therefore the two opposite end cases must have their ends pinched and secured from fire. The method of firing such wheels is, by carrying a leader from the mouth of one of the first cases to that of the other, which leader being burnt through the middle will give fire to both at the same time.

Water squibs are generally made of 1^{oz.} serpent cases, 7 or 8 inches long, filled $\frac{2}{3}$ with charge, and the remainder bounced. The common method of firing them is:—Take a water wheel, with a tin mortar in its centre, which load with squibs after the usual method; but the powder in the mortar must be no more than will just throw the squibs out, (easily into the water:) you may place the cases on the wheel, either obliquely, or horizontally; and on the top of the wheel, round the mortar, fix six cases of brilliant fire, perpendicular to the wheel. These cases must be fired at the beginning of the last case of the wheel and the mortar at the conclusion of the same.

To fire sky rockets under water.—You must have stands made as usual, only the rails must be placed flat, instead of edgewise, and have holes in them for the rocket sticks to go through; for if they were hung upon hooks, the motion of the water would throw them off. The stands being made, if the pond is deep enough, sink them at the sides, so deep that when the rockets are in, their heads may just appear above the surface of water; to the mouth of each rocket fix a leader, which put through the hole with the stick; then a little above the water must be a board, supported by the stand, and placed along one side of the rockets; then the ends of the leaders are turned up through holes made in this board, exactly opposite the rockets. By this means you may fire them singly, or all at once. Rockets may be fired by this method, in the middle of a pond, by a Neptune, a swan, a water wheel, or any thing else you chuse.

Water Fire-Fountains.—To make a fire fountain you must first have a float, made of wood, 3 feet diameter; then in the middle fix a round perpendicular post, 4 feet high and 2 inches diameter. Round this post fix three circular wheels, made of thin wood, without any spokes. The largest of these wheels must be placed within two or three inches of the float, and must be nearly of the same diameter. The second wheel must be 2 feet 2 inches diameter, and fixed at 2 feet distance from the first. The third wheel must be 1 foot 4 inches diameter, and fixed within 6 inches of the top of the post. The wheels being fixed, take 18 four or 8 ounce cases, of brilliant fire, and place them round the first wheel, with their mouths outwards, and inclining downwards; on the second wheel place 13 cases of the same, and in the same manner as those on the first; on the third place 8 more of these cases, in the same manner as before: and on the top of the post fix a gerbe; then clothe all the cases with leaders, so that both they and the gerbe may take fire at the same time. Before you fire this work, try it in the water, to see if the float is properly made, so as to keep the fountain upright.

SHELL WORK.

SHELLS have long been used by the ladies in making fancy work; sixty or seventy years since, this was particularly the fashion, and large *grottos*, on which extravagant sums had been expended, were not uncommon, besides a multiplicity of fancy work in shells of all sorts. Mr. Hughes, in his "History of Barbadoes," has two pages, vindicating the ladies against the imputation of extravagance and waste of time in their passion for this shell work, but his argument goes rather to prove that this pursuit is more improving than many others which the fair sex of his time followed, than that it is altogether such as ought to engross their minds to the extent it did. Though this taste is disappearing, shells are still in this country made into fancy baskets, vases, ornaments for head dresses, &c., the manufacture of which is chiefly carried on as a real art, and for profit, and as such, is of course as valuable, as far as it goes, as any other branch of ornamental industry. Though all species are occasionally used, the principal seem to be the rice shell, the rose shell, the green shell, some species of *Tellina*, &c. from the West Indies. At Taranto, shell-work is a regular business, but the articles are chiefly pictures, resembling mosaic work, picture frames, &c. The shells

are stuck one by one, according to their shades, upon pasteboard, on which lines have previously been drawn. The articles are very expensive, and being of course of little use, they are purchased rather as curiosities than otherwise. There are also some manufactures of a like nature in France.

Shells are generally used of their natural colors, and there is no transparent color whatever which is not found in some species of this interesting family, yet it often happens that the shells of the desired color are not perhaps of the requisite shade, in which case it is advisable to stain them. This is not so easy as some may imagine, because the external surface of shells is a very hard and impervious enamel; and even those colors which readily penetrate ivory and bone will not always stain a shell. The only colors fit for the purpose are of a vegetable or animal nature; and these, although they will succeed with some shells, completely fail with others, and the worst of the matter is, that the most glossy and beautiful shells are the most difficult to stain. The following receipts may be tried as most likely to be successful:—Boil the shells along with shreds of scarlet cloth, to which add a little pearlsh; to brighten the color afterwards boil them again in a solution of chloride of tin. For a red they may be boiled along with logwood, Brazil wood, or madder, a little vinegar brightens the color, a little alum renders it more purple. Soak them without boiling in verdigris dissolved for a green, or in blue stone dissolved for a light blue. Boil them in sulphate of indigo for a dark blue; boil them with weld or quercitron bark for a yellow, and in walnut shell liquor for a brown. When wanted for shell flowers dipping the flowers when made in melted wax, transparent or colored, gives a fine transparency to them, and takes off the harshness which shell work always has.

QUERIES.

In using iron, instead of zinc, for galvanic batteries, is it necessary to steep the plates in dilute acid?
—Yes, most certainly; they are to be treated in precisely the same manner, and although sulphuric acid is a solvent for iron, it is not more so than for zinc. Indeed the chemical action that takes place promotes, if it does not occasion the electrical; the reason that iron is used is because it is cheaper than zinc.

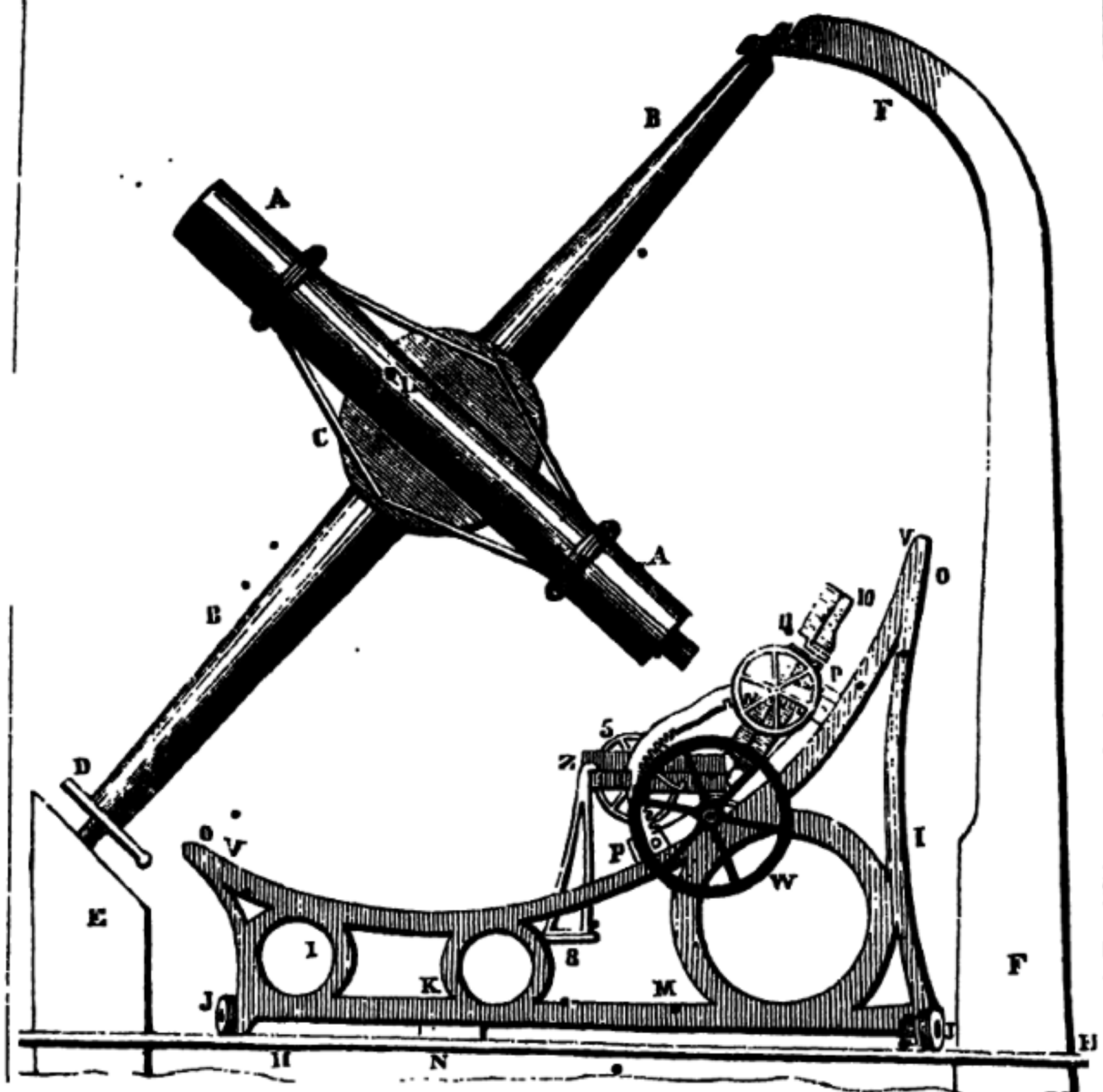
What are the proportions of aquafortis and water for pickling brass work, &c., previous to tacking?
—This must depend upon the strength of the acid; let so much water be added as will make it very slightly acid to the taste.

What is the use of the prism?—Its principal use is, that it may refract the rays of light; and as ordinary light consists of rays of various colors, and of different degrees of refrangibility, it separates these rays from each other, producing an imitative rainbow, or rather a band of the colors of the rainbow; and therefore explaining numerous phenomena of light.—A prism is also used as the object-glass of the camera lucida, and also in the telescope invented by Dr. Wollaston; both of which instruments we have previously described.

How is the paper prepared for the metallic pencil memorandum books?

What are the processes and instruments used in clay modelling?

Why do lake colors soon spoil when ground up with oil, and is there any remedy for this state?



SPERRING'S OBSERVATORY CHAIR.

To possess the means of placing the body in a position of perfect repose is an advantage of inestimable price to those who are engaged in making micrometric observations on double stars and other celestial objects; for, howsoever complete may be the provision for stability in the construction of the instrument, the restrained positions of the observer are only maintained by the tension of those muscles which are least accustomed to continued action; and the consequent agitation of his body produces an apparent tremulous motion of the object in the field of the telescope.

Mr. Sperring constructed this chair for the observatory at the residence of G. Bishop, Esq., South Villa, Regent's Park, that gentleman having previously explained to him the nature of the inconveniences to be obviated. By horizontal and vertical motions the chair may be placed in a position corresponding to the azimuth and altitude of the star to be observed, while, by a still more valuable part of the contrivance, the observer may place his eye close to, or at any required distance from, the eyepiece of the telescope, his head and whole frame being so completely supported as to allow him to

relax every muscle. This chair is adapted to a telescope mounted on a polar axis, and is therefore provided with every requisite motion; by which an observer, whilst seated in it, may raise or lower himself in any required position, to whatsoever part of the heavens the telescope may be directed.

The fig. is a view of the west side of the telescope and axis, the chair, and the carriage on which it is mounted. Drawn on a scale $\frac{1}{10}$ of the original. A A the telescope on the polar axis B B, which is placed parallel to the earth's axis; C the divided circle of declination, and D the circle for right-ascensional motion; E the lower support; F the upper support. These supports are built on the earth independent of the observatory, and rise through the floor H H without touching it, the crevices being concealed by the carpeting of the floor; the carriage I I stands on four wheels J J, so as to roll round the centre bolt K, placed under the centre L, of the telescope, and follow the motion of the telescope. The carriage has a floor M M, through which the bolt K is passed into the centre block N. O O, the two side-rails of the carriage between which the chair is supported so as to be capable of moving from end to end; they are therefore arcs of circles described from the centre L, by which the chair, when moving, preserves its distance from the eye-piece of the telescope whilst accompanying its motion. P P, the base of the chair, is a strong frame fitting easy between the rails O O, its curve being the same as that of the rails, and having curved brass bars or tongues throughout its whole length, firmly screwed at each side; these enter curved brass grooves, which are let into the inner sides of the two rails O O, from end to end; by these the chair is confined, and supported between the rails so as to be capable of sliding from end to end. For the purpose of moving the chair up and down the curved rails O O, two pinions are mounted on one axis, which passes through the chair base P. These travel on two curved racks V, which are let in flush with the top of the rails, and extend from end to end. The observer, whilst seated, pulls round the wheel W on the right-hand side, which is secured on the same axis with the two pinions and thus moves himself along the rail: a ratchet wheel and click are placed on each side close to the pinions by which the chair is retained at its place; both the clicks are mounted on one axis which passes through the base, so that one hand will lift both, when the chair is to be lowered. A tooth projecting from this axis is acted on by a spring, so as either to keep the clicks in action, or hold them quite up whilst the chair descends.

The seat and back of the chair are both made moveable for the purpose of enabling the observer to adjust himself comfortably to the telescope at any part of the rail. The middle cross bar of the frame P is much thicker than the frame, and rises above it where the seat Z and the back of the chair 11, are hinged to it. To support the seat, an axis is passed across near the front of it, having a pinion at each side of the seat, with clicks and ratchets. These pinions are moved by the hand-wheel 5 on the left side, and the seat is thus raised or lowered. In like manner the back may be raised or lowered by moving the wheel on the right side, the pinions of which work also in two racks. These racks for the back, though joined to those of the seat in two bows, are yet curved from their separate centres. These bows answer the purpose of arms to the chair. The foot-board 8 is hung to the seat by two metal

hooks, one hook being shown separate. When observing stars near the pole, the seat of the chair is made the back, and the back the seat, because the polar axis will not allow of the complete revolution of the carriage round its centre bolt; therefore, the foot-board 8 is made to unhook; and, for the same reason, the head-board 9 is made to unhook, that they may change places. In this case the clicks are not used; but a contrary one is made to act in a contrary ratchet. The head-board 10 is shown a little detached in order that its hook may be seen. 11 is a cushion. The head-board may be the whole width, or made in halves.

In this chair an observer can follow the telescope in every direction, and shape the chair to the most comfortable form, so as to support and adjust his head with the greatest nicety to the telescope. The clock which moves the telescope is governed by a fly instead of a balance or pendulum, because a continuous motion is required; and it is connected with the tangent-screw D, by a clutch which is made to slide in or out of contact; the observer, while in his seat, being enabled to turn the tangent-screw by means of a long-handled key, and thus gradually move the telescope without the clock. The dome of the observatory stands on a circular frame of rollers on the wall, and has a series of iron pins projecting inwards to serve as a rack. A lever hanging on a pin in the wall will always engage any one of the rack pins that may be over it, and so move the dome till its opening is brought to the right place. The opening is covered by a shutter made to slide, one way to open and the other way to shut, by means of cords passing over two pulleys.

TO OBTAIN GLUCINUM AND YTTRIUM.

GLUCINA, supposed to be the oxyde of a metal, and to which, therefore, the term glucinum has been given, is a light, tasteless, white, and soft powder, discovered by Vauquelin in the aqua marina and the beryl; from the later, it may be obtained in the following manner:—

Analysis of the beryl.—Process 1.—A given weight of the beryl, in fine powder, is to be fluxed, as usual, with three times its weight of potassa, and every thing soluble removed by subsequent boiling in distilled water to which has been added muriatic acid in excess; evaporate to dryness, digest the dried mass in hot distilled water, and throw the whole upon a filter; what remains, after elutriation, is the silica contained in the stone.

2.—The glucina and alumina, now in combination with the muriatic acid, are to be thrown down by carbonate of potassa: collect the precipitate on a filter, wash with distilled water, and redissolve in sulphuric acid.

3.—To the super sulphate of glucina and alumina, add a small quantity of sulphate of potassa, taking care not to leave any great excess of sulphuric acid in solution: but, if present, it must be removed by the addition of a due quantity of carbonate of potassa, evaporate the solution rather low, and set aside in a covered vessel; crystals of alum will fall, and by subsequent evaporation, a second portion will be obtained.

4.—When the whole of the sulphate of alumina and potassa have been thus obtained, add carbonate of ammonia in sufficient quantity to dissolve the whole of the glucina, what remains is the alumina.

5.—Filter the ammoniacal liquor in the last process; evaporate to dryness, and ignite in a covered crucible; what now remains is pure glucina.

6.—The quantity of alumina in the crystallized alum is to be ascertained either by referring to the scale, or by decomposing their solution in water by ammonia, when obtained, its weight is to be added to that portion collected in process 4. Glucina has not been applied to any useful purpose.

Yttrium.—Yttria was first discovered by Professor Gadolin, in a mineral from Ytterby, in Sweden, and named, in honor of its discoverer, Gadolinite. This mineral is of a black or velvet black color; it generally occurs either disseminated or massive, seldom crystalline; with a vitreous lustre and conchoidal fracture; hardness, between felspar and quartz; brittle; specific gravity, 4.2. Its constituents are yttria, silica, the oxydes of iron, and cerium and volatile matter. Before the blow-pipe it runs into a slag, which is generally magnetic.

As obtained in the following analysis, yttria, is a white powder, of specific gravity 4.52; possessing neither taste nor smell; infusible *per se*, but readily so on the addition of a borax, with which it forms either a transparent or opaque glass according to the quantity added. Yttria is soluble in many of the acids, but not in fixed alkalies; carbonate of ammonia, in great excess, however, dissolves it. With the exception of the sulphate of yttria, which is soluble, its salts are very similar to those with base of lime; yttria is supposed to be a metallic oxyde, and the base has therefore been called yttrium. The soluble salts of yttrium are decomposed by the carbonate and phosphate of soda, oxalate of ammonia, and the ferro cyanate, and tartrate of potassa.

Analysis. 1.—A given quantity of the gadolinite in fine powder is to be mixed with thrice its weight of caustic potassa, the mass thus obtained is to be digested in distilled water, and the solution evaporated to throw down a portion of oxyde of manganese generally contained.

2.—The remaining solution, together with the undissolved residue are to be mixed with nitric acid in excess, and evaporated to dryness. On resolution in water, the silice and oxyde of iron will remain: they may be separated by digestion in muriatic acid, which will take up the latter, and leave the former. Ammonia in excess will precipitate the oxyde of iron.

3.—If any lime has been contained in the specimen thus subjected to analysis, a few drops of carbonated alkali will now separate it, after which, the careful addition of hydrosulphuret of ammonia will separate the remainder of the oxyde of manganese.

4.—Precipitate the yttria by adding to the remaining fluid caustic ammonia, and the analysis is finished.

MANUFACTURE OF FILES.

THE file is a well known steel instrument, having teeth upon the surface for cutting and abrading metal, ivory, wood, &c. When the teeth of these instruments are formed by a straight sharp-edged chisel, extending across the surface, they are properly called files; but when by a sharp-pointed tool, in the form of a triangular pyramid, they are termed rasps. The former are used for all the metals, as well as ivory, bone, horn, and wood; the latter for wood and horn. Files are divided into two varieties, from the form of their teeth. When the teeth are a series of sharp edges, raised by the flat chisel, appearing like parallel furrows, either at right angles to the length of the file, or in an oblique direction,

they are termed *single cut*. But when these teeth are crossed by a second series of similar teeth, they are said to be *double cut*. The first are fitted for brass and copper, and are found to answer better when the teeth run in an oblique direction. The latter are suited for the harder metals, such as cast and wrought iron and steel. Such teeth present sharp angles to the substance which penetrate it, while single cut files would slip over the surface of these metals. The double cut file is less fit for filing brass and copper, because its teeth would be very liable to become clogged with the filings.

Files are also called by different names according to their various degrees of fineness. Those of extreme roughness are called rough; the next to this is the bastard cut; the third is the second cut; the fourth, the smooth; and the finest of all, the dead smooth. The very heavy square files used for heavy smith-work are sometimes a little coarser than the rough; they are known by the name of rubbers. Files are also distinguished from their shape, as flat, half-round, three-square, four-square, and round. The first are sometimes of uniform breadth and thickness throughout, and sometimes tapering. The cross section is a parallelogram. The half-round is generally tapering; one side being flat, and the other rounded. The cross section is a segment of a circle, varying a little for different purposes, but seldom equal to a semi-circle. The three-square generally consists of three equal sides, being equilateral prisms, mostly tapering; those which are not tapering are used for sharpening the teeth of saws. The four-square has four equal sides, the section being a square. These files are generally thickest in the middle, as is the case with the smith's rubber. In the round file, the section is a circle, and the file generally conical.

The heavier and coarser kinds of files are made from the inferior marks of blistered steel. Those made from the Russian iron, known by the name of old sable, called from its mark CCND, are excellent. The steel made from the best Swedish iron, called hoop L or Dannemora, makes the finest Lancashire files, for watch and clock makers; a manufacture for which the house of Stubbs in Warrington is celebrated. The steel intended for files is more highly converted than for other purposes, to give them proper hardness. It should however be recollected, that if the hardness be not accompanied with a certain degree of tenacity, the teeth of the file break, and do but little service. Small files are mostly made of cast steel, which would be the best for all others, if it were not for its higher price. It is much harder than the blistered steel, and from having been in the fluid state, is entirely free from those seams and loose parts so common to blistered steel, which is no sounder than as it comes from the iron forge before conversion.

The smith's rubbers are generally forged in the common smith's forge, from the converted bars, which are, for convenience, made square in the iron before they come into this country. The files of lesser size are made from bars or rods, drawn down from the blistered bars, and the cast ingots, and known by the name of tilted steel. The file-maker's forge consists of large bellows, with coke as fuel. The anvil-block, particularly at Sheffield, is one large mass of mill-stone girt. The anvil is of considerable size, set into and wedged fast into the stone; and has a projection at one end, with a hole to contain a sharp-edged tool for cutting the files from the rods. It also contains a deep groove for

containing dies or bosses, for giving particular forms to the files. The flat and square files are formed entirely by the hammer. One man holds the hot bar, and strikes with a small hammer. Another stands before the anvil with a two-handed hammer. The latter is generally very heavy, with a broad face for the large files. They both strike with such truth as to make the surface smooth and flat, without what is called hand-hammering. This arises from their great experience in the same kind of work. The expedition arising from the same cause is not less remarkable. The half-round files are made in a boss fastened into the groove above mentioned. The steel being drawn out, is laid upon the rounded recess, and hammered till it fills the die.

The three-sided files are formed similarly in a boss, the recess of which consists of two sides, with the angle downwards. The steel is first drawn out square, and then placed in a boss with an angle downwards, so that the hammer forms one side, and the boss two. The round files are formed by a swage similar to those used by common smiths, but a little conical. The file-cutter requires an anvil of a size greater or less, proportioned to the size of his files, with a face as even and flat as possible. The hammers weigh from one to five or six pounds. The chisels are a little broader than the file, sharpened to an angle of about 20 degrees. The length is just sufficient for them to be held fast between the finger and thumb, and so strong as not to bend with the strokes of the hammer, the intensity of which may be best conceived by the depth of the impression. The anvil is placed in the face of a strong wooden post, to which a wooden seat is attached, at a small distance below the level of the anvil's face. The file is first laid upon the bare anvil, one end projecting over the front, and the other over the back edge of the same. A leather strap now goes over each end of the file, and passes down upon each side of the block to the workman's feet, which, being put into the strap on each side like a stirrup, holds the file firmly upon the anvil as it is cut. While the point of the file is cutting, the strap passes over one part of the file only, the point resting upon the anvil, and the tang upon a prop on the other side of the strap. When one side of the file is single cut, a fine file is run slightly over the teeth, to take away the roughness; when they are to be double cut, another set of teeth is cut, crossing the former nearly at right angles. The file is now finished upon one side, and it is evident that the cut side cannot be laid upon the bare anvil to cut the other. A flat piece of an alloy of lead and tin is interposed between the toothed surface and the anvil, while the other side is cut, which completely preserves the side already formed. Similar pieces of lead and tin, with angular and rounded grooves, are used for cutting triangular and half-round files. Rasps are cut precisely in the same way, by using a triangular punch instead of a flat chisel. The great art in cutting a rasp is to place every new tooth as much as possible opposite to a vacancy.

GROUND-ICE.

BY PROFESSOR MERIAN

THE name of *ground-ice* is given to the detached and separated masses of ice, which running waters carry at their surface during a frost of some duration. This ice differs from that continuous kind which is formed along the edge of rivers, and par-

ticularly in places where the water is quiet; it never forms in lakes, pools, or other stagnant water, and motion appears to be a condition essential to its existence. At first sight it might be taken for an aggregation of snow penetrated by water, swimming at the surface, rather than for ice; but a closer examination will not fail to discover its true characters. In fact, it is formed of an assemblage of a multitude of small, thin, and rounded plates of ice, having a diameter of a few lines. They are individually transparent, but their aggregation presents, at a distance, the appearance of a semi-transparent mass, like wet snow. It is known that, before rivers begin to carry the ground-ice, the temperature of the air must have been for several days previous some degrees below zero; and it is observed in general, that a cold wind, blowing in a direction contrary to the current of the river, is singularly favorable to the formation of this sort of ice.

We might at first be induced to suppose that the ice in question must be formed at the surface, as is the case with that of smooth water, because the effect of the cooling of the atmosphere is more intensely felt at the surface, and water at a temperature below 40° Fahr., that is, below the point of its greatest density, becomes lighter, in proportion as the cold augments. It might, therefore, be supposed, that water which is near the point of congelation, has a tendency to remain above, and that, consequently, the ice should begin to form at the surface. But although this is the case with regard to standing water, it is different with respect to streams; in them the ground-ice is really formed upon the soil which constitutes their bed. Any person may easily convince himself of the fact, in a pretty severe winter, by examining what takes place in a river which carries ice, and which is shallow enough to let him see the bottom. In the winter of 1823, the canal of St. Alban, which conducts the waters of the Birse through the town of Basle, carried a considerable quantity of ground-ice. The clearness of the water was such that objects were distinctly visible at a depth of 3 feet. The bed of the canal in this place is covered with rolled pebbles. Wherever a projection was perceived at the bottom of the water, in the deep places as well as those less so, there was seen a bundle of bits of ice which had been formed there, and which, at a distance, presented the appearance of cottony tufts. In several places nearly the whole bottom was covered in this manner, and the fasciculi were detached from time to time, and came up to the surface of the current, which is very rapid. The fasciculi which were taken up by the hand from the bottom, presented exactly the same appearance as those which rose to the surface of themselves, and which were floating about in great quantities. They were composed, like the latter, of small rounded and agglomerated plates of ice; so that no doubt could exist with regard to the origin and mode of formation of the floating ice. The uniform and peculiar arrangement of the ice which appeared at the bottom of the water, entirely excludes the supposition that it might have been precipitated from the surface.

The following explanation of this phenomenon is what M. Merian considers the most natural. If it be true that, in winter, running water is first cooled at the surface, it is also true, that its constant agitation, especially when aided by a wind blowing in a direction contrary to that of the current, continually mixes the water of the surface and that of the bottom, notwithstanding the inconsiderable difference

of their specific gravities. The temperature of the bottom and that of the surface, even in pretty deep rivers, does not present any remarkable difference, while the prominent bodies fixed to the bottom present points of attachment to the forming ice, much more advantageous than a constantly-agitated surface; and it is well known what influence these points or nuclei have in general upon crystallisation. The water sufficiently cooled begins, therefore, to be converted into ice at the bottom, particularly in the places where shelter is afforded by prominences from the impetuosity of the current. The continual motion which takes place in the interior of the water presents the same obstacle to the formation of large masses of ice, which is presented to the crystallization of common salt by agitation of the liquid which holds it in solution; and there are only formed in consequence simple agglomerations of small plates of ice imperfectly crystallized. When these agglomerations have accumulated, so as to present larger masses, they are detached from the bottom, either by virtue of their greater lightness, or from the impulse of the current, and rise to the surface, frequently carrying with them fragments of the soil itself. In fact, it is not uncommon to find sand, gravel, mud, or other substances, attached to the ground-ice, and floating with it upon the surface.

He then mentions his having searched, in different authors, for observations which might serve to confirm or refute the above theory, but with little success; for modern writers seem to have overlooked the subject, and it is almost exclusively in the older works that any particular notice is taken of it. Plot, in his "History of Oxfordshire," observes, that all the watermen with whom he has had an opportunity of speaking on the subject, agree in thinking, that the rivers of the country always begin to freeze at the bottom. He describes the manner in which the small pieces of ice, called *ice-meers*, rise from the bottom to the surface, and mentions their frequently containing gravel or stones, which they have carried along with them. Hales confirms these observations; and says, that the watermen of the Thames assert, that, some days before that river is frozen at the surface, they feel the ice at the bottom with their poles, and that they see it rising to the surface. He gives, also, several observations of his own, clearly establishing the fact. These observations, M. Merian remarks, serve to show, that the ideas indicated by the German name, *grundeis*, are generally diffused among the country people in England, and present a detailed relation of facts, furnished by an observer whose accuracy can be relied upon; and from these facts we may conclude, that there forms, at the bottom of running water, not only an ice disposed in tufts, but also, when the circumstances are favorable, a layer of compact ice.

Of the more recent observations upon this subject, he mentions that of Mr. Streaks, who relates, that, at Pillau, chains of iron, 6 feet in length, which had remained for a long time lost at the bottom of the water; a cable, 30 fathoms long; and stones, weighing from 3 to 6 pounds, were raised to the surface, inclosed in a thick envelope of ice; and that an anchor, after having remained an hour in the water, was taken out covered with a layer of ice.

In conclusion, the author observes, that, after having adduced proofs of the formation of ice at the bottom of running water, he has to remark, that it cannot by any means be pretended that this ice, once raised from the bottom to the surface, does not fragment in a remarkable manner. This result, on

the contrary, appears probable: because the pieces of ice, which are already found at the surface, being at least as cold as the bottom, must present nuclei, whose presence contributes to the freezing of the water. This freezing of the surface will especially extend, when, from any circumstance whatever, the ground-ice may be stopped in some places, and will there form a more or less compact mass. Nor does he deny, that, in certain cases, ice may be formed, even at the surface of running water; but he thinks it sufficiently established that ice is formed at the bottom of brooks and rivers; and the characters of this ice, being entirely similar to those of the ground-ice which floats at the surface, it is more than probable that they have a common origin, and a common mode of formation.

WHALEBONE AND ITS MANUFACTURE.

WHALEBONE may be considered as a kind of horn; which latter substance it resembles perfectly, both in its chemical and principal physical properties, and is particularly interesting as forming the transition from horn to hair. It is the substitute for teeth in the Greenland whale, and in the black southern whale; but is not found in any of the cetaceous animals that have teeth. The food of the Greenland whale is a small crustaceous animal not so large as a common shrimp; and the whalebone forms the apparatus by which this huge animal secures the minute prey that he lives on. From the roof of the mouth hang down on each side the tongue about three hundred blades of whalebone, all the blades on one side being parallel to each other, and at right angles to the jawbone. On account of the arched form of the roof of the mouth, the blades about the middle of the series are the longest, and they diminish gradually towards each end. The average length of the middle blades is about 9 feet; but they have occurred of the length of 14 or 15 feet. These blades hang down in the mouth so that the hairy side shall be the innermost; the hairs forming a net or filter through which the water escapes, leaving the shrimps behind.

The surface of the blade is compact, and susceptible of a high polish by mere friction. Its texture is lamellar in the direction of its breadth, so that it easily splits and divides in this direction, but not in that of the thickness of the blade; the middle of the blade is of a looser texture than the rest, and is technically called the grain, being composed of coarse, bristly hairs. The general color of whalebone is a dusky greyish black, intermixed with thin stripes, or layers of a paler color, which are often almost white—very rarely the entire flake is milk-white. The preparation of the whalebone for use is very simple. It is boiled in water for several hours, by which it becomes soft enough to be cut up, while hot, in lengths of different dimensions, according to the use to which it is to be applied; of, by means of a compound guarded knife, is cut into fibres for brushes, which are at present extensively used in stables for the first process in cleaning a horse. Whalebone that has been boiled, and has become cold again, is harder and of a deeper color than at first; but the jet-black whalebone has been dyed. The principal consumption of whalebone at present is for stretchers to umbrellas and parasols; it is also used, though not so much as formerly, in giving stiffness to women's stays. Whips are also made of platted whalebone, both black and white; the latter are very beautiful. White whalebone has

also been made into ladies' bonnets, and likewise into artificial flowers, as its texture is well adapted to this purpose; and it will, by the usual dyeing processes, take very bright and durable colors.

FRENCH WEIGHTS AND MEASURES.

THE French metrical system is founded on a single standard of length, called a *metre*, and which is equivalent to the ten-millionth part of the arc of the meridian, extending from the equator to the pole. The length of the metre, at the temperature of 32°, as ascertained by Captain Kater (*Phil. Trans.*, 1818), is 39,37079 English inches.

The French measures increase and decrease in decimal proportions, a distinctive prefix being put to the term by which the integer is called. These prefixes are *deca*, *hecto*, *kilo*, and *myria*, taken from the Greek numerals, to express the multiplication of the integer by 10, 100, 1000, and 10000 respectively; and *deci*, *centi*, and *milli*, from the Latin numerals, to express the division of the integer by 10, 100, 1000; as in the following table:—

	Metres.		Metre.
1 Myriametre..	= 10000	1 Metre	= 1
1 Kilometre ..	= 1000	1 Decimetre..	= .01
1 Hectometre..	= 100	1 Centimetre..	= .001
1 Decametre ..	= 10	1 Millimetre ..	= .0001

The metre is the integer of the measure of length, and from it all measures of surface, capacity, and weight, are deduced; as follows:—

For square dimensions, the metre, or its parts squared, are employed. When used for measuring land, the term *are* is adopted, which is a decametre squared. An *hectare*, or 100 *ares*, is about equal to 2 English acres.

For the integer of the measure of capacity, the cubed decimetre is employed, under the name of *litre*, which is about equal to 2½ English wine pints.

For the integer of the measure of weight, the weight of a cubic centimetre of distilled water, at 32°, has been adopted; it is called a *gramme*, and is equal to 15.4 English grains.

The following are the principal tables of French weights and measures:—

Measures of Length.

Millimetre....	=	.03937	English Inches.
Centimetre...	=	.39371	"
Decimetre....	=	3.9371	"
Metre.....	=	39.37100	"
Decametre....	=	10 yds., 2 ft., 9.7	in.
Hectometre..	=	109 "	1 " 1 "
Kilometre....	=	1093 "	1 " 10½ "
Myriometre ..	=	10936 "	0 " 6 "

Measures of Capacity.

Millilitre....	=	.06103	Cubic Inches.
Centilitre...	=	.61038	"
Decilitre....	=	6.1038	"
Litre.....	=	2.1133	pints.
Decalitre....	=	2 gallons, 5.1352	pints.
Hectolitre...	=	26.419	gallons.
Kilolitre....	=	264.2	"
Myriolitre...	=	2642	"

Measures of Weight.

Milligramme..	=	.0154	English Grains.
Centigramme..	=	1544	"
Decigramme..	=	1.5444	"
Gramme.....	=	15.444	"
Decagramme..	=	5.65	drams.
Hecagramme..	=	3 oz. 8.5	"
Kilogramme ..	=	2 lb. 3 oz. 5	"
Myriogramme	=	22 lb. 1 oz. 2	"

MAKING OF CRAYONS.

The perfection of the crayons consists, in a great measure, in their softness, for it is impossible to execute a brilliant picture with them if they are otherwise; on which account great care should be observed in the preparing them, to prevent their being hard. In all compositions, flake white, and white lead should be always rejected, because the slightest touch with either of these will unavoidably turn black.

The usual objection to crayon paintings, is that they are subject to change, but whenever this happens, it is entirely owing to an injudicious use of the above-mentioned whites, which will stand only in oils. To obviate the bad effects arising from the use of such crayons, let the student make use of common whiting prepared in the following manner:—Take a large vessel of water, put the whiting into it, and mix them well together; let this stand about half a minute, then pour off the top into another vessel, and throw the gritty sediment away; let what is prepared rest about a minute, and then pour it as before, which will purify the whiting, and render it free from all dirt and grittiness. When this is done, let the whiting settle, and then pour the water from it; after which lay it on the chalk to dry, and keep it for use, either for white crayons, or the purpose of preparing tints with other colors, for with this all other tints may be safely prepared.

The student must be provided with a large, flexible palette knife, a large stone and muller to levigate the colors, two or three large pieces of chalk to absorb the moisture from the colors after they are levigated, a piece of flat glass to prevent the moisture from being absorbed too much till the colors are rolled into form, and vessels for water, spirits, &c. as necessity and convenience shall direct.

REDS.

Carmine and Lake.—It is rather difficult to procure either good carmine or good lake. Good carmine is inclined to the vermilion tint, and should be an impalpable powder, and good lake to the carmine tint. The carmine crayons are prepared in the following manner:—As their texture is inclinable to hardness, instead of grinding and rolling them, take a sufficient quantity of carmine, lay it upon the grinding stone, mix it with a levigating knife with spirits of wine, till it becomes smooth and even; yet the less friction produced by the knife the better. The chalk stone being ready, lay the color upon it to absorb the spirit, but be careful that it is laid on in a proper shape for painting.

The simple color being prepared, the next step is to compose the different tints by a mixture with whiting; the proportion to be observed consisting of twenty gradations to one, which may be clearly understood by the following directions:—Take some of the simple color, and levigate it with spirits of wine, adding about one part of washed whiting to three parts of carmine, of which, when properly incorporated, make two parcels. The next gradation should be composed of equal quantities of carmine and whiting, of which four crayons may be made. The third composition should have one fourth carmine, and three fourths whiting; of this make six crayons, which will be a good proportion with the rest. The last tint should be made of whiting, very faintly tinged with carmine, of which make about eight crayons, which will complete the above-mentioned proportion. Though these tints made with whiting may be rolled, yet the pure carmine

will not bear it, but must be left on the chalk-stone till perfectly dry.

Lake is a color very apt to be hard; to prevent which, the student must observe the following particulars:—Take about half the quantity of lake intended for the crayons, and grind it very fine with spirits of wine; let it dry, and then pulverize it, which is easily done if the lake is good; then take the other half and grind it with spirits; after which mix it with the pulverized lake, and lay it out directly in crayons on the chalk. The color will not bear rolling. The simple color being thus prepared, proceed with the compound crayons as directed before, and in the same degree of gradation as the carmine tints.

Vermillion, or Native Cinnabar.—The best is inclined to the carmine tint. To prepare this color, mix it on the stone with soft water or spirits, after which it may be rolled into crayons.

BLUES AND GREENS.

Prussian Blue is a color very apt to bind, and is considered soft with more difficulty than carmine and lake. The same method of preparation is to be followed with this as is directed with respect to lake, only it is necessary to grind a larger quantity of the pure color, as it is chiefly used for painting draperies.

Blue Verditer is a color naturally gritty, and therefore it is necessary to wash it well. Its particles are so coarse as to require some binding matter to unite them, otherwise the crayons will never adhere together. To accomplish this, take a quantity sufficient to form two or three crayons, to which add a piece of slacked plaister of Paris about the size of a pea; mix these well together, and form the crayons upon the chalk. This blue is extremely brilliant, and will be of great use in heightening draperies, &c.

Greens.—Brilliant greens are produced with great difficulty, and may be procured of those who make it their business to prepare them; yet the following compositions will be found useful:—Take yellow ochre, and after grinding it with spirits, mix it with the powder of Prussian blue; then temper it with a knife, and lay the crayons on the chalk without rolling them; besides this use king's yellow, mixed with Prussian blue, brown ochre, and Prussian blue. The crayons made of these last may be rolled.

YELLOWS.

King's Yellow is the most useful and most brilliant, levigated with spirits of wine and compose the different tints as before directed. Yellow ochre, and Naples yellow, ground with spirits, will make useful crayons.

Orange is produced with king's yellow and vermillion, ground together with spirits, and the tints formed as in other cases; but no great quantity of them is required.

BROWNS.

Cologne Earth is a fine dark brown. After six or eight of the simple crayons are prepared, several rich compound tints may be produced from it, by a mixture with carmine in various degrees; black, carmine, and this color mixed together, make useful tints for painting hair; several gradations may be produced from each of these by a mixture with whiting.

Umber.—May be treated in just the same manner, only it is necessary to levigate it with spirits of wine.

Purples.—Prussian blue ground with spirits, and mixed with pulverized lake, will produce a good purple. Carmine thus mixed with Prussian blue will produce a purple something different from the

former. Various tints may be made from either of these compounds by a mixture with whiting.

BLACK.

Lamp-Black is the only full black that can be used with safety, as all others are subject to mildew.

Cinnabar mixed with Carmine.—This is a composition of great use, and tints made from this with whiting will be found very serviceable.

Carmine and black is another good compound, of which five or six gradations should be made, some partaking more of the black, and others having the carmine most predominant, besides several tints by a mixture with whiting.

Cinnabar and black is also a very useful compound, from which several different tints should be made.

Prussian blue and black is another good compound, and will be found of singular service in painting draperies.

It is impossible to lay down rules for forming every tint necessary in composing a set of crayons, there being many accidental compositions entirely dependent on fancy and opinion. The student should make it a rule to save the leavings of his colors, for of these he may form various tints which will occasionally be useful.

REVIEW.

Claxton and Morton's Companions. (Taylor and Walton, Gower Street.)

Two little works at a shilling each, forming portions of a series, have lately been published, with the object of explaining the nature of a collection of apparatus formed by Messrs. Claxton and Morton for the use of schools, and those engaged in private education. The apparatus appears simple, and from its construction is necessarily cheap; two strong recommendations. The small books accompanying it, one of which is entitled, *Companion to Atwood's Machine*, the other *Companion to Apparatus on Hydrostatics, Hydraulics, and Pneumatics*, are very useful for the young, though they go but a little way to explain the phenomena of these important subjects. Each is assisted by explanatory cuts, and contains several original experiments. We have been particularly pleased with the illustration of the pendulum,—having however treated of this subject long ago, we rather quote another portion, that on the description of an air pump, or as it ought rather to have been called of the condensing and rarefying syringe, and a few experiments on the expansion of air.



"Description of the small air pump."

—A small air pump for exhausting and condensing, consisting of a single barrel in which a piston moves, having a valve on its upper side; a ground brass plate is attached to the lower end of the barrel, which is to be placed on the top of the ground glass receivers to remove the air from within. The ground plate has a hole through its centre, in which one end of a double screw piece is inserted; this double screw has a valve tied over one end of it, and should be so inserted that the valve opens towards the barrel in exhausting, and from it in condensing. That end of the screw projecting from the pump, and inserted in the foot, is for attaching a glass tube, or any

vessel used for exhausting or condensing. There is also a small hook which screws into this piece for suspending articles in the receiver. The upper side-screw is represented in its place as the pump is used for exhausting, but must be inserted into the bottom of the piston to render it solid, when the pump is used for condensing. The air is admitted by the lower side-screw, or when that is removed, then the air is admitted by sliding the plate of the pump. The lower side-screw also acts as a lever in reversing the lower valve. The foot is for the pump to stand upon when not in use. In condensing, the piston should be made to strike both at top and bottom of the barrel; and in exhausting the piston should strike the bottom, but need not be brought quite to the top of the barrel. The piston and valves should be kept well oiled with sweet oil.



" *Expansion of air.*—On removing the pressure from any portion of air it expands; but, to show that it does so, we are obliged to confine it so that it may not be removed with that portion which we wish to exhaust.

" *Fig. 1. Bladder to show Expansion.*—A bladder partly filled with air and tied up to prevent its escape, is placed inside a glass receiver; and the ground plate of the pump, being oiled a little, is placed upon the receiver. In pumping the air out of the vessel, we remove it from the outside of the bladder, when the inclosed air meeting with less resistance expands and fills the bladder. On re-admitting the air to the receiver, it presses again upon the outside of the bladder, and the air which is within resumes its former bulk. The air is admitted in this case by sliding the pump.

" *Withered Fruit restored.*—A shrivelled apple and some other fruits, if the skin is moist and not broken, will, while under an exhausted receiver, appear plump and fresh. These may be suspended from the hook of the pump.

" *Fig. 2. The Bell-head, or Inverted Bottle.*—A small bottle inverted in a receiver one-third filled with water. On removing the air from the surface of the water in the receiver, the air in the bottle expands, and escapes through the water. If half the air has escaped, the bottle will be half filled with water on letting the air into the receiver, and so of any other proportion. The quantity of water passing into the bottle denotes the degree of exhaustion of the air. The water will remain elevated in the bottle until the pressure of the air is again restored. The mercury is supported in the barometer upon this principle.

" *Fig. 3. Expanded Bubbles.*—With a little soap and water in an exhausted receiver a quantity of bubbles will be produced, with a dark appearance, on account of their being too thin to reflect the light. Warm fermented liquor will appear to boil in vacuo; but the ground glass jars are not adapted for producing the boiling, or ebullition of water in vacuo. This should be performed with an oil flask,

which being thin is not so likely to break. Let the flask be about one-fourth filled with boiling water, put a cork into the mouth, and invert it into a basin of water an inch or so, to keep out the air; then the steam may be condensed by touching the top of the flask with a damp cloth, and the water will recommence boiling.

" *Fig. 4. A Balloon rising in Water by Expansion.*—The balloon is a glass vessel placed in water with its open end downwards. A portion of the air is removed by the pump, and water enough is admitted into the balloon just to sink it. After this, a very little movement of the piston will cause it to rise to the surface of the water. On the other hand, if the balloon be just light enough to float, a very little extra pressure on the surface of the water will cause it to sink.

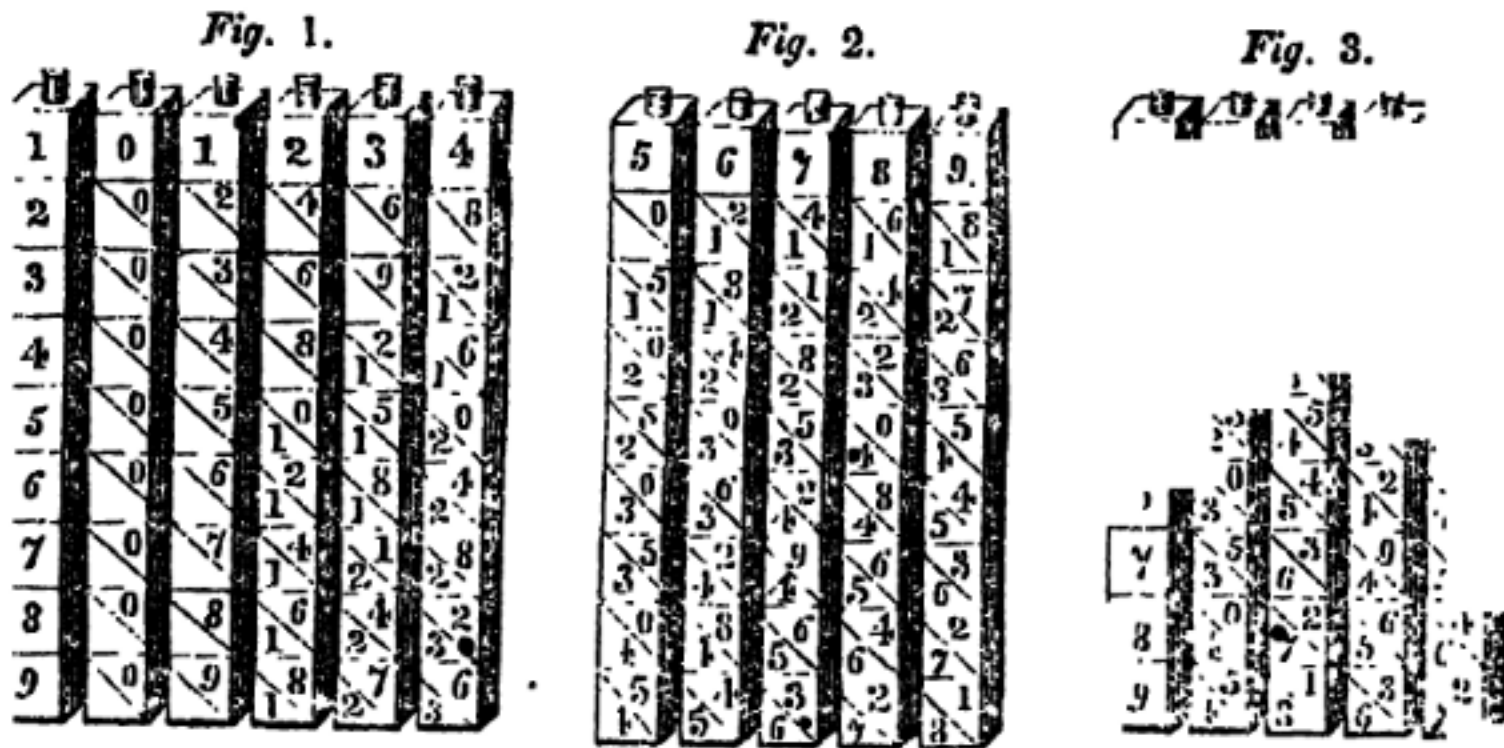


" *Fig. 5. Porosity of Wood, &c.*—A block of wood is suspended in water having a lead weight to sink it. On removing the pressure of the air from the surface of the water, air bubbles may be seen rising from the ends of the wood, and will continue to rise copiously for some time. Firestone, pumice stone, &c. may be used in further illustrations.

" *Fig. 6. Wood turnings and saw dust,* with a number of small air bubbles adhering, will sink in water, and on the pressure of the air being removed from the surface of the water, the small bubbles of air will expand and buoy the particles of wood up again, which may be repeated two or three times. All kinds of wood will sink in water, which may be shown by cutting off thin slices across the grain, that the air may escape more readily when they are placed on the surface of the water. Logs of timber are sometimes too heavy at the butt end to float, and it is a practice to bore holes with a large augur for the admission of air—the water being kept out by a short plug—which renders them specifically lighter and enables them to float. Air is frequently used in bladders, bags, barrels, and other vessels, on account of its lightness, in the construction of life preservers, and to raise sunken vessels.

" *Figs. 7 and 8. Fountain by Expansion.*—A glass receiver, with a brass plate, stop cock, and jet pipe, for a fountain in vacuo, with the pump attached in the position for exhausting the receiver. The metallic air vessel is to be half filled with water, and the side pipe stopped with a screw; then, having exhausted the receiver, shut the cock, and removed the pump, attach the short brass tube to the end of the stop cock, pass it into the air vessel, and screw it down. When, on opening the stop cock, the confined air in the vessel will expand, and press the water up through the jet pipe into the receiver, with considerable force, as shown in fig. 8."

The wood-cuts depicted above are of the exact size of those given in the work quoted: and, as will be evident, are illustrative of the apparatus made by Messrs. Claxton and Morton



NAPIER'S CALCULATING BONES.



ALEXANDER'S EYE SHADE.

NAPIER'S CALCULATING BONES.

THE rods, known by the name of Napier's bones or rods, were contrived by Lord Napier for the more easy performing of the arithmetical operations of multiplication, division, &c. These rods are six in number, made of bone, ivory, horn, wood, paste-board, or any other suitable material. The faces of five of them are divided into nine little squares, each of which, except the top one, is parted into two

triangles by diagonals. In these little triangles are written the numbers of the multiplication table, in such a manner, as that the units or right hand figures are found in the right-hand triangle, and the tens, or the left hand figures, are in the left-hand triangle. Let the first rod be numbered with 1, 2, 3, and 4 times. The next rod with 5, 6, 7 and 8 times. The third rod with 9, 0, 1 and 2. The fourth rod with 3, 4, 5, 6. The fifth with 7, 8, 9, 0. Some sets of the bones consist of only

these five, in which each figure occurs exactly twice, and all operations of multiplication and division can be performed by them, supposing the number to be multiplied, or in other cases the divisor do not contain more than five figures, and no one figure occurs more than twice. If these conditions are not borne out, other rods numbered in the same way must be used in addition to the five just mentioned.

The numbering of these rods is given in Fig. 1 and 2, and also in addition to them in No. 1 is shown a sixth rod, divided into squares, in which the digits only are placed in regular order downwards; this is called the *unit rod*. To multiply numbers by Napier's bones, dispose the rods in such a manner as that the top figures may exhibit the multiplicand, and to those on the left hand join the rod of units or one, in which seek the right-hand figure of the multiplier, and the numbers correspondent to it in the squares of the other rods. Write out, by adding the several numbers occurring in the same rhumb together, and their sums. After the same manner, write out the numbers corresponding to the other figures of the multiplier, disposing them under one another as in common multiplication; and, lastly, add the several numbers into one sum. For example, supposing the multiplicand 5978 and the multiplier, the rods as in figure 1. Then in common multiplication, the product will be found as follows:

$$\begin{array}{r}
 5978 \\
 \times 937 \\
 \hline
 41846 \\
 17934 \\
 53802 \\
 \hline
 5601386
 \end{array}$$

By attention to the above, and reference to the arrangement of the rods in Fig. 1, the method of doing the sum by their means will be rendered very easy. From the outermost triangle, which corresponds to the right hand figure of the multiplier 7, write out the figure 6, placing it under the uppermost line. In the next two triangles towards the left are 5 and 9; add these together, and their sum being 14, put down 4 and carry 1. Then add the 1 to the two next figures, which with them, will make 8; put that down on the left of the 4; after the same manner, add the next figures 6 and 5; the sum of these being eleven, you will set down 1 and carry 1. This is to be added to the three found in the last triangle. The 4 thus arising is to be placed on the left of the 1846 already put down; thus you will have 41846 for the product of 5978 by 7. In the same manner are to be found the products for the other figures of the multiplier, after which the whole is to be added together as usual.

To perform division, dispose the rods so that the uppermost figures may exhibit the divisor; to those on the left hand join the rod of units; descend under the divisor, till you meet those figures of the dividend in which it is first required how often the divisor is found, or at least the next number which is to be subtracted from the dividend; then the number corresponding to this, in the place of units set down for a quotient; and, by determining the other parts of the quotient in the same manner, the division will be completed. For example, suppose the dividend 5601386 and the divisor 5978.

$$\begin{array}{r}
 5978 \overline{) 5601386} \quad (937 \\
 \underline{53802} \\
 22118 \\
 \underline{17934} \\
 41846 \\
 \underline{41846} \\
 \hline
 \dots
 \end{array}$$

Since it is first required how often the divisor is found in the five first figures of the dividend, descend until by adding the numbers together in the manner given before, and which may be done mentally and at once, you find in the lowest row the number 53802, approaching nearest to 56013, the former of which is to be subtracted from the latter, and the figure 9 corresponding to it in the rod of units set down for the quotient. To the remainder 2211 join the following figure 8 of the dividend, and the number 17934 being found as before, for the next less number to it: the corresponding number 3 in the rod of units is to be set down for the next figure of the quotient. After the same manner the third and last figure of the quotient will be found to be 7, and the whole quotient 937.

ALEXANDER'S EYE SHADE.

THE common green silk shade used by persons with weak eyes is made of pasteboard, and is fastened round the head by means of a ribband at each extremity. Such a shade cannot be retained in its place unless it rest against the forehead; the consequence of which is, that the air warmed by contact with the face, collects beneath the shade, there being scarcely any space between it and the forehead through which it may escape. Thus the eyes, already in a weak and irritable state, are rendered worse and more relaxed by the hot air that is continually applied to them; whereas, if the shade were allowed to project clear from the forehead, there would be a continual draught through the vacant space, and the eyes would have the benefit not only of shade but also of coolness. This is effected in Mr. Alexander's eye shade, the support of which is a light springy frame, which gently grasps the head in so convenient a manner, that the weight of the shade will not alter its position.

Fig. 1, is a perspective view of the shade. Fig. 2 represents it as worn on the head. The shade does not touch the head any where, and it only touches the supporting frame at two opposite points just above the ears. At these places there are screws with binding nuts, that fix the shade in any position. The places of these screws is such, that whether the shade be lowered quite before the face, or raised out of the way quite over the head, it will not touch the head or face in any part, and therefore never checks or interferes with the natural perspiration, and never becomes soiled by wearing.

A A is the bow of the frame, it goes over the head. B B two side arms; the parts B and C are one piece, the bow A being rivetted to them at D and E. The lower margin of the shade is wire, but the upper margin F is a bow of thin steel; its two ends F F are perforated to be put in the side screws, which are furnished with nuts to bind it tight. Fig. 3 is a section of one screw, and its binding nut and all the parts as bound together. Fig. 4 is one of the collets. The screw has a broad base, which is rivetted

to the lower part of B C ; the end of the bow F is placed against this base, and followed by the collet or washer G, and then bound fast by the nut H ; a pin projects from the side of the screw, and enters the recess of the collet shown in Fig. 4, to prevent that collet from turning round ; thus loosening the nuts will not move the shade, but allows it to be moved, and the weight of the shade can have no effect in loosening the nuts. The holes in the bow F have similar recesses, to enable them to pass the pin when put on or taken off. Every part of the springy support that touches the head is covered with silk.

This shade is to be purchased at Mr. Ackerman's, in the Strand, London, but was invented by Mr. Alexander, an optician, we believe, of Exeter.

GENERAL DISTRIBUTION OF THE ANIMAL KINGDOM.

There exist four principal forms, four general plans, if it may be thus expressed, on which all animals appear to have been modelled, and the ulterior divisions of which, under whatever title naturalists may have designated them, are merely slight modifications, founded on the development or addition of certain parts, which produce no essential change in the plan itself.

Vertebrate Animals. (Animalia vertebrata).—In the first of these forms, which is that of man, and of the animals which most resemble him, the brain and the principal trunk of the nervous system are inclosed in a bony envelope, which is formed by the cranium and the vertebrae ; to the sides of this medial column are attached the ribs, and the bones of the limbs, which compose the framework of the body : the muscles generally cover the bones, the motions of which they produce, and the viscera are contained within the head and trunk. Animals of this form have all red blood, a muscular heart, a mouth furnished with two jaws, placed one either before or above the other, distinct organs of sight, hearing, smell, and taste, situated in the cavities of the face ; never more than four limbs ; the sexes always separated ; and a very similar distribution of the medullary masses, and of the principal branches of the nervous system. On examining each of the parts of this great series of animals more closely, there may always be detected some analogy, even in those species which are most remote from one another : and the gradations of one single plan may be traced from man to the last of fishes.

Molluscan Animals. (Animalia mollusca).—In the second form there is no skeleton ; the muscles are attached only to the skin, which constitutes a soft, contractile envelope, in which, in many species, are formed stony plates, called shells, the production and position of which are analogous to that of the mucous body ; the nervous system is contained within this general envelope, together with the viscera, and is composed of several scattered masses, connected by nervous filaments, and of which the principal, placed over the oesophagus, bears the name of brain. Of the four senses, the organs of those of taste and vision only can be distinguished ; the latter of which are even frequently wanting. A single family alone presents organs of hearing. There is always, however, a complete system of circulation, and particular organs for respiration. Those of digestion and of the secretions are little more complicated than in the vertebrated animals.

Although the general plan of their organization is not so uniform, as regards the external configuration of the parts, as that of the vertebrates, there is always an equal degree of resemblance between them in the essential structure and the functions.

Articulate Animals. (Animalia articulata).—The third form is that observed in insects, worms, &c. Their nervous system consists of two long chords running longitudinally through the abdomen, dilated at intervals into knots or ganglions. The first of these knots, placed over the oesophagus, and called brain, is scarcely any larger than those which are along the abdomen, with which it communicates by filaments that encircle the oesophagus like a collar. The envelope of their trunk is divided by transverse folds into a certain number of rings, of which the teguments are sometimes hard, sometimes soft, but to the interior of which the muscles are always attached. The trunk often bears on its sides articulated limbs, but is frequently unfurnished with them. It is among these that the passage is observed from the circulation in closed vessels, to nutrition by imbibition, and the corresponding transition from respiration in circumscribed organs, to that effected by tracheae or air-vessels distributed through the body. The organs of taste and vision are the most distinct in them, a single family alone presenting that of hearing. Their jaws, when they have any, are always lateral.

Radiate Animals. (Animalia radiata).—Lastly, the fourth form, which embraces all those animals known under the name of *Zoophytes*. In all the preceding, the organs of sense and motion are arranged symmetrically on the two sides of an axis. There is a posterior and an anterior dissimilar face. In this last division, they are disposed as rays round a centre ; and this is the case, even when they consist of but two series, for then the two faces are alike. They approximate to the homogeneity of plants, having no very distinct nervous system, nor organs of particular senses ; there can scarcely be perceived, in some of them, the vestiges of a circulation ; their respiratory organs are almost always on the surface of the body ; the greater number have only a sac without issue, for the whole intestine ; and the lowest families present only a sort of homogeneous pulp, endowed with motion and sensibility.

"The necessity," writes Mr. Owen, "for a dismemberment of the *Radiata* of Cuvier, which Rudolphi justly calls a chaotic group, has been felt, and directly or indirectly expressed, by most naturalists and comparative anatomists. It is impossible, indeed, to predicate a community of structure in either the locomotive, excretive, digestive, sensitive, or generative system, with respect to this division, as it now stands in the *Règne Animal*. * * *

"Taking the nervous system as a guide, the *Radiata* of Cuvier will be found to resolve themselves into two natural groups, of which the second differs in the absence or obscure traces of nervous filaments from the higher division, in which these are always distinctly traceable, either radiating from an oral ring, or distributed in a parallel longitudinal direction, according to the form of the body.

"These different conditions of the nervous system are accompanied by corresponding modifications of the muscular, digestive, and vascular systems ; and a negative character, applicable to the higher division of Cuvier's *Radiata*, may be derived from the generative system.

Acrete Animals. (Animalia acrita).—It is only

in the lower-organized of these divisions, to which the term has been applied by Macleay, also that of *Protozoa* and *Oozoa* by Carus (from the circumstance of its members being analogous to the ova or germs of the higher classes), that the alimentary cavity and sanguiferous canals are destitute of proper parietes, being simple excavations or passages in the granular pulp of the body; for in the *Nematoneura* (a name applied to the higher division of Cuvier's *Radiata* by Owen), the digestive organ is provided with a proper muscular tunic, and floats in an abdominal cavity: and those classes which manifest a circulating system distinct from the digestive tube possess vessels with proper parietes, distinguishable into arteries and veins. No nematoneurous class presents an example of generation by spontaneous fission or gemmation, but these modes of reproduction are common in the acrite division. Some of the latter, however, are oviparous; and in a few the sexes are separate.

DIFFERENT KINDS OF VESSELS.

(Resumed from page 211.)

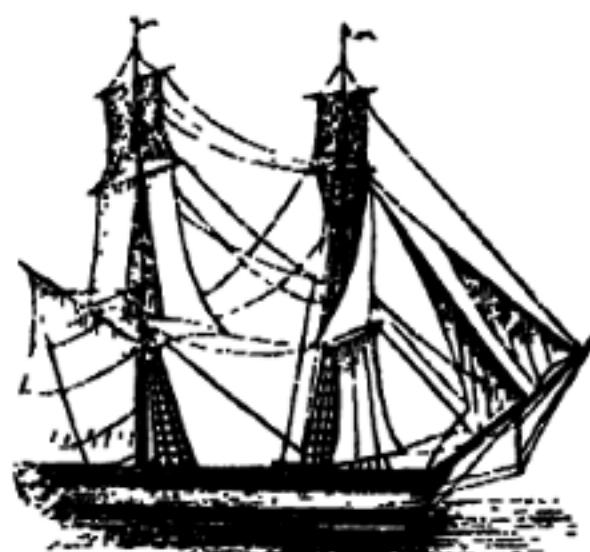
We have devoted considerable space already to the important subject of ship-building, but the article would not be complete without some account of the various kinds of large vessels in common use, particularly those used for peaceful services. Unfortunately this part of the subject is one that cannot be rendered clear by mere description; on the contrary, illustrative wood-cuts of themselves are immediately understood. We have therefore prepared a series of such cuts, which we shall introduce almost without description, feeling ourselves incompetent to state the peculiar advantages of each kind of vessel, and without that we are aware that the account can have no claim to science.

A *ship*, properly speaking, has three masts; and, of course, such an one, used for the purposes of commerce, would be properly called a merchant ship, such as is represented beneath:—



It is customary to call the above a *Merchantman*, but this term is equally applicable to a two-masted vessel, or a *Brig*, as follows. The brig is distinguished not merely by having two masts, but by having her main-sail set nearly in a line with her keel; whereas the main-sails of larger ships are set more or less across the vessel. In a three-masted vessel this main-sail hangs to a yard, which is parallel with the deck; but in a brig the main-sail slides up and down the main-mast by means of rings.

It is fastened to a boom below, and is drawn up by a gaff above; most of the sails are also square.



The *Schooner* has two masts like a brig, but has two of its sails suspended by gaffs; that is, its main-sail and fore-sail. They are fastened to booms below, and the upper sails of the vessel are only square on the fore-mast, and more angular on the main-mast, than are those of the brig. Some schooners however have square top-sails. The schooner is usually a fast-sailing vessel.



The *Lugger* is a small vessel, sometimes of two, and at others of three masts, distinguished by the manner in which the sails are attached to the masts, and the character of the sails themselves, which are called lug sails, and which are supported above by a yard which is not affixed to the mast by the middle, but at about one-third the length of the yard; this is not expressed well in the cut, though important, yet the cut will show the character of the lugger. Small boats, with only a small mast, and moveable sail, are also often called luggers.



A *Wherry*.—By this term we usually consider a boat used for pleasure, and which does not carry sails or masts; but there is a kind of wherry used in fishing made with two moveable or fixed masts.

each of which bears a single sail, as shown beneath. This vessel is very common in Scotland, and other places northward.



Dutch Galliot.—This well-known vessel is the chief coasting ship of the Dutch. It may be seen constantly in our larger rivers, bringing us eggs, poultry, fruit, cheese, and other produce. The vessel carries a main and mizen mast, and a large gaff main-sail. The masts are supported by four or five pair of shrouds, and a stay which sets up to the stem; over this stay is another which leads to the end of the bowsprit. These vessels are very sea-worthy, and although not fast sailers, yet hold an immense quantity of merchandise. A smaller Dutch vessel is called a *Schuyt*.



One-masted vessels and boats will form a subject for another paper.

OBSERVATIONS ON PHOTOGRAPHIC PROCESSES.

BY W. F. CHANNING.

IN the photographic preparations of silver, the agency of light is confined to a change in the arrangement of the particles, or to a partial decomposition. As in galvanic decomposition, it is assisted by coinciding chemical affinities, and these may be brought to act on the salt of silver either in the preparation before exposure to light, or afterwards to bring out the impression. In the Daguerreotype mercury seems to act mechanically in making apparent the molecular change wrought in the iodide of silver by the action of light. In the recent photographic processes of Talbot, however, a chemical agent is used subsequently to complete the decomposition which light had begun.

A sensitive preparation of silver is one in which the elements are so delicately balanced as to be overturned by the slightest cause. The fulminating compounds of silver are examples of such a com-

position, and may form hereafter preparations very sensitive to light. None of the more simple salts of silver are immediately reduced by light, though it may afterwards be made apparent by chemical means that they have undergone a change of structure, or that a subsalt has been formed. Thus chloride of silver is apparently insensible to light, unless, for example, organic matter, containing carbon, oxygen, and hydrogen be associated with it, when the affinity of the carbon for the oxygen, and of the oxygen for the chlorine, immediately determines a reduction. Thus carbon reduces the oxide of silver in many of its oxy-salts. Electro-positive bodies, therefore, which are associated with the salt of silver, tend directly or indirectly to decompose it, by removing the electro-negative principle combined with the silver, while an excess of electro-negative elements, oxygen, chlorine, &c., as in the perchlorate, chlorate, and hypochlorate of silver, retards decomposition. Thus compounds, such as phosphorus, tannic, gallic, crenic, fulminic acids, which may be termed deoxidizing agents, all absorbing oxygen, and also another series acting mechanically, such as mercury, deserve attention, first in making a photographic preparation; and, second, in bringing out an impression after the action of light. There are singular reactions, however, constantly observed in photographic chemistry, which cannot be comprehended or explained by any general statement.

In a recent process a paper is first prepared with iodide of silver, and then washed with ferrocyanide of potassium and used moist. The ferrocyanide contains carbon, potassium, iron, and nitrogen without oxygen. Mixed in powder with substances abounding in oxygen, such as nitrate or chlorate of potash, it explodes by heat or percussion. In this case, it is easy to see that if water were present a slight cause would determine its oxygen to the ferrocyanide, and its hydrogen to the iodine of the silver. Water in the form of water of crystallization, hygroscopic moisture, or artificially applied, often thus performs an important part in these preparations. The cyanide of potassium is equally or more efficacious than the ferrocyanide. Besides the inconvenience of using a moist paper, this is not so sensitive as Talbot's calotype paper, founded on his important discovery of the properties of gallic acid.

For this the paper is washed successively with nitrate of silver and iodide of potassium: then, before using, with a mixture of acetic acid, nitrate of silver, and gallic acid, which must be made at the time. After a short exposure in the camera, the paper, still apparently unchanged, is washed again with the above mixture, when the impression begins to grow upon the paper in a very striking and beautiful manner. The objection to this process is its complication. The following is a very simple modification of it, nearly as sensitive, and more so than the original Daguerreotype plates:—A piece of best glazed letter paper is fastened by means of a pen-knife point, and some hard wood pegs, to a piece of smooth pine board. It is washed over once quickly and evenly by means of a camel's hair brush, with a solution of sixty grains crystallized nitrate of silver in one ounce of water. Let it dry spontaneously, and as soon as dry wash it for a minute with a brush and solution of ten grains of iodide of potassium in one ounce of water. Then instantly wash it with water by dipping it three or four times in a suitable vessel, and dry it by pressing it gently between blotting paper. It is then ready for the camera. One minute is sufficient for a building on

huts by the creeks' sides for the benefit of the sea breezes, as near the logwood groves as they can, removing often to be near their business: yet when they are settled in a good open place, they choose rather to go half a mile in their canvas to work than lose this convenience. Though they build their huts but slightly, yet they take care to thatch them very well with palm or palmet leaves, to prevent the rains, which are there very violent, from soaking in.

For their bedding they raise a barbecue, or wooden frame, three feet and a half above ground, on one side of the house, and stick up four stakes, at each corner one, to fasten their curtains; out of which there is no sleeping for mosquitoes. Another frame they raise covered with earth for a hearth to dress their victuals; and a third to sit at when they eat it. During the wet season, the land where the logwood grows is so overflowed that they step from their beds into the water, perhaps two feet deep, and continue standing in the wet all day till they go to bed again; but nevertheless account it the best season for doing a good day's labour in.

Some fell the trees, others saw and cut them into convenient logs, and one chips off the sap, and he is commonly the principal man; and when a tree is so thick that after it is logged it remains still too great a burden for one man, they blow it up with gunpowder. The logwood-cutters are generally sturdy strong fellows, and will carry burdens of three or four hundred-weight; but every man is left to his choice to carry what he pleaseth, and commonly they agree very well about it: for they are contented to labour very hard. In some places, especially in the west creek of west lagoon, they go a hunting wild cattle every Saturday to provide themselves with beef for the week following. When they have killed a beef they cut it into quarters, and taking out the bones, each man makes a hole in the middle of his quarter, just big enough for his head to go through, then puts it on like a frock and trudgeth home; and if he chanceth to tire, he cuts off some of it and throws it away.

The hides of these wild cattle, and many which they killed merely for their hides, were another valuable article of commerce to these hardy adventurers. Many of these men make considerable sums of money; and Dampier remarks, generally, that those who had the advantage of some education were careful to improve their time, industrious and frugal; but that those who did not possess this advantage "would extravagantly squander away their time and money in drinking and making bluster."

As these settlements continued to be regarded with an hostile eye by the Spaniards, the introduction of the logwood-tree into Jamaica was attempted in 1715. Seeds were procured from Campeachy for this purpose, and the growth of the plants was found to be so rapid, that in three years they attained to the height of ten feet. In a comparatively short period this tree flourished abundantly in the island, large plantations were formed for the purpose of cutting, and the tree has so multiplied that in the course of years it has become completely naturalized in Jamaica. The success attendant on its cultivation in that island, did not, therefore, by any means cause a cessation of the demand for Campeachy wood, and accordingly the cutters still continued to contend with the Spaniards for the right of cutting down these trees.

(To be continued.)

MANUFACTURE OF FISH-HOOKS

FISH-HOOKS are constructed with simple tools, but require great manual dexterity in the workmen. The iron wire of which they are made should be of the best quality, smooth, and sound. A bundle of such wire is cut in lengths, either by shears or by laying it down upon an angular wedge of hard steel, fixed horizontally in a block or anvil, and striking off the proper lengths by the blows of a hammer. In fashioning the *barbs* of the hooks, the straight piece of wire is laid down in the groove of an iron block made on purpose, and is dexterously struck by the chisel in a slanting direction, across so much of the wire as may be deemed necessary. A sharp-pointed little wedge is thus formed, whose base graduates into the substance of the metal.

The end of the wire where the line is to be attached is not flattened or screw-tapped; the other end is sharp pointed, and the proper twisted curvature is given. The soft iron hooks are next case-hardened, to give them the steely stiffness and elasticity, by imbedding them in animal-charcoal, contained in an earthen or iron box; after which they are brightened by heating and agitating them with bran, and finally tempered by exposure to a regulated temperature upon a hot iron plate. Hooks for salt-water fishing are frequently tinned, to prevent them wearing rapidly away in rust.

QUERIES.

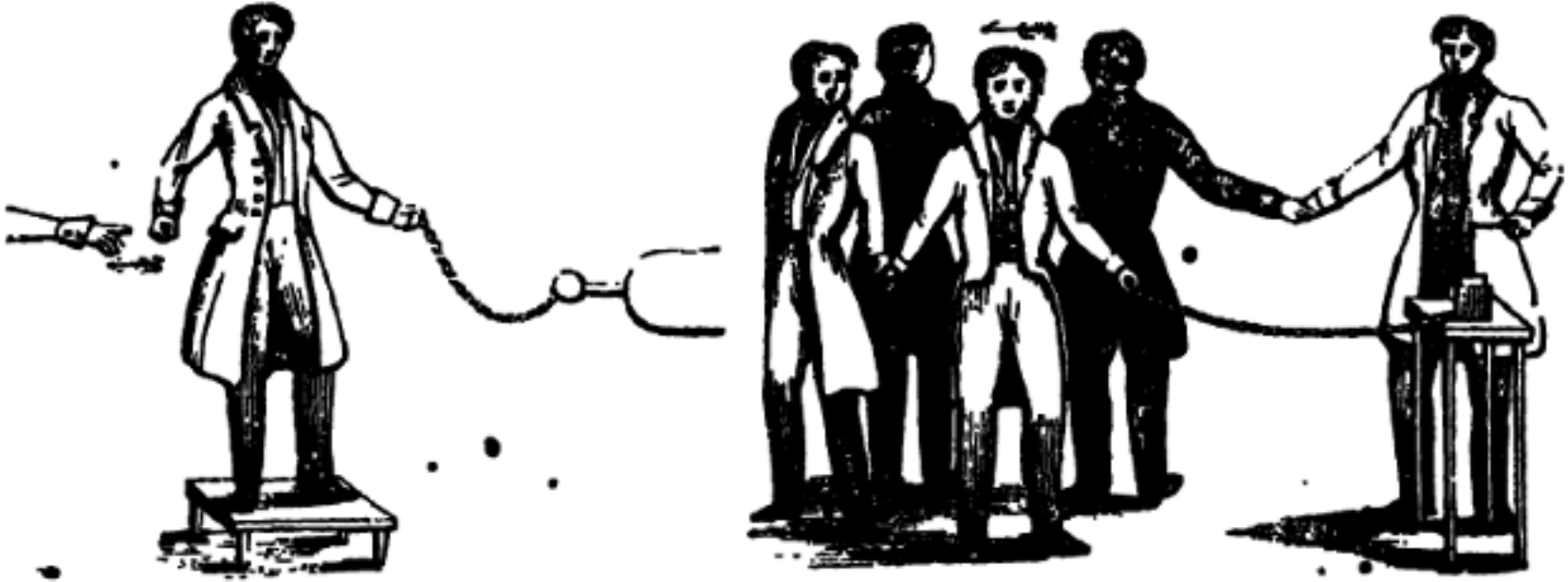
Why cannot iron be precipitated by the electrotype process?—Metals are relatively with each other negative or positive in their electrical action. At present it is only the positive metal, such as copper, silver, platina, &c., which have been deposited—the ordinary battery of copper and zinc being used. If the battery were constructed of iron and tin, it is probable, that as iron would then be the positive metal, it might be precipitated; yet a battery constructed of materials so similar to each other as iron and tin would have but little energy. At any rate fresh discoveries must be made before lead, tin, iron, zinc, &c. can be deposited by galvanism. Metals cannot be precipitated in the form of alloys.

Why will not iron wire do as a substitute for copper in electro-magnetic instruments?—Iron wire will do quite as well as copper, but it is not used because it is more liable to break, more stubborn, and therefore less convenient; so liable to rust and difficult to solder, that the connections made with iron wire are seldom good, yet for all this, some persons use it, and it is said, that the effect is even more powerful when the secondary coil is of iron.

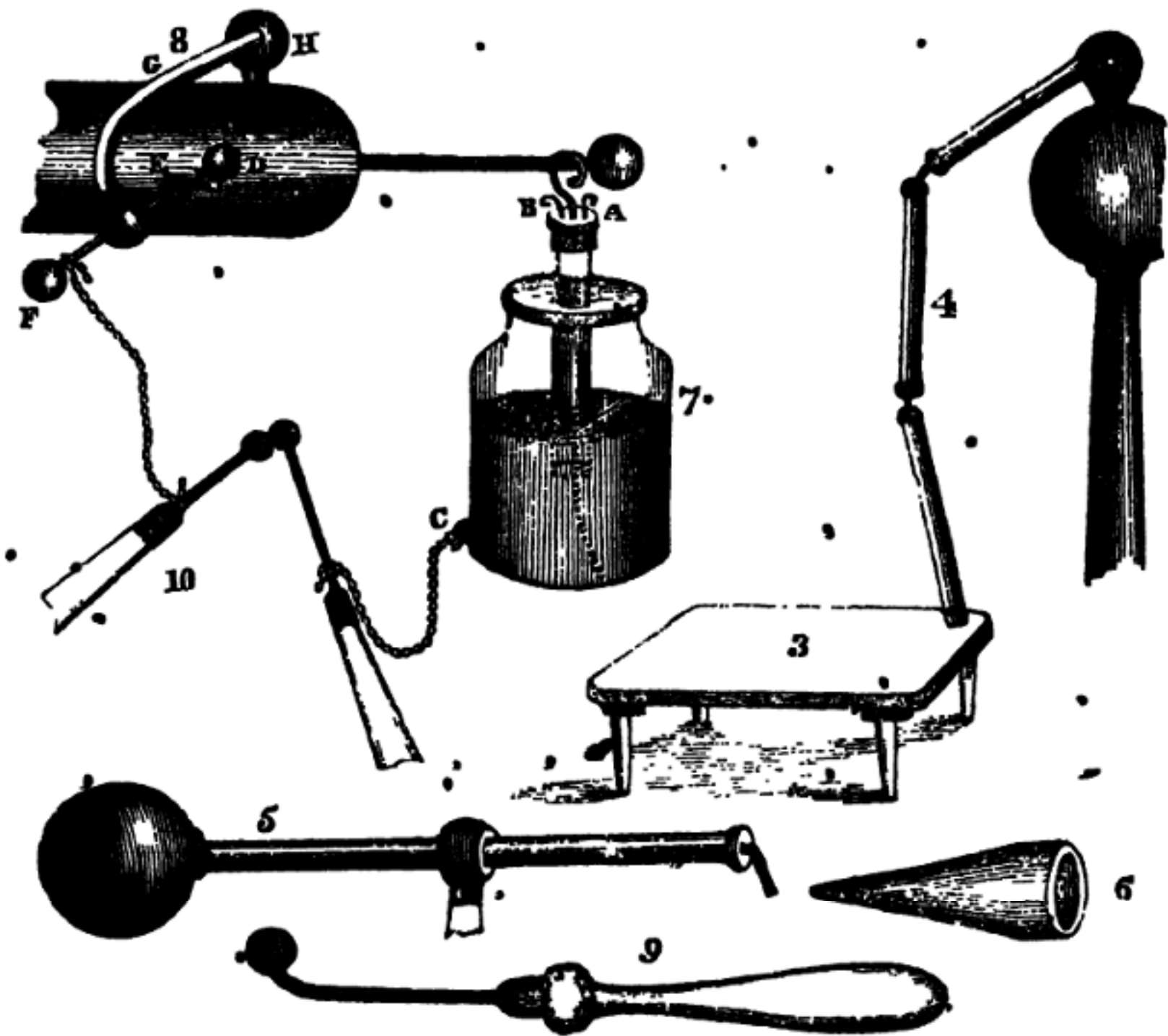
What should be the temper of the steel bars of which magnets are made?—Two or three years ago there was much scientific discussion upon this matter, and also upon the kind of steel best adapted for magnets; some preferring cast and others sheer steel,—we have always used the former, and at that temper at which it usually is received from the ironmongers. If made harder than this, it is difficult to impregnate the steel with magnetism; yet it is admitted, that the harder the steel, the longer it retains the magnetism given to it.

How is whalebone stained?—There is little difficulty in dyeing white whalebone; those colors which we have previously given for dyeing wool will have the same effect upon whalebone and hair: seldom any other colors than red and blue are required.

Fig. 1.



MEDICAL ELECTRICITY.



MEDICAL ELECTRICITY.

THIS is a subject which we have perhaps too long delayed, considering the importance that was once attached to it; and although electricity is not, what it was once thought, a universal panacea, yet for many disorders it has been proved efficacious, where other remedies have failed. Many years since we practised medical electricity to some considerable extent, and although we are obliged to confess that its effects were not always beneficial with the same disease, yet with many of those wherein medicine fails, electricity is most frequently beneficial, if not wholly as a cure, at least as a very great palliative. Let it not be thought that the remedy is worse than the disease, as those who subject themselves to the powerful shocks given by the electrical apparatus of our various institutions are apt to believe; on the contrary, it may be administered to sleeping children without waking them, and even when awake its application may be made a source of gratification rather than of apprehension. To administer electricity properly requires considerable skill and tact in the operator, and as this is seldom found so surely as among medical men, and as they neither like the trouble of operating, nor are taught any thing of the curative effects of the fluid during their medical studies, they who are best able to administer it with effect are regardless of it altogether. Electricity, according to the mode of its administration, is either sedative, stimulant, or deobstruent; hence the propriety of its application to diseases of quite contrary character. We have applied it, (with what success we may hereafter state,) to palsies, rheumatisms, inflammations, contractions of the muscles, amaurosis, chilblains, tumours, sprains, and other diseases and accidents. The methods of electrifying are five; first, simple electrization, or merely subjecting the person to the action of electricity, by placing him on a glass-legged stool, connecting him with the electrical machine when in use. Second, drawing the fluid from the particular part of his body which may be affected. This is either done by holding towards him a wooden point, when a cooling and refreshing breeze is perceptible, or by placing your hand upon his clothing, when if any woollen or silk interpose between your hand and his body he will feel a peculiar pricking sensation, occasioned by innumerable sparks, issuing from the part beneath the hand, and which will soon occasion a great degree of warmth in that part. Or a third method is to draw the fluid from him by means of sparks, taken by the knuckle, or else by a wire with a metallic ball at the end of it. If the operator hold this tight he will not feel the sparks himself. This mode of electrization is shown in Fig. 1. A stronger way of drawing off electricity is by means of what are called *vibrations*, and a still stronger, *sparks*. For these two last the patient sits on an ordinary chair, and not on the glass stool before mentioned, or he may stand, if more convenient to him.

The first requisite for the medical electrician to understand is his apparatus, and which is very different from that wanted for experimental purposes. The following is all that is essentially necessary, though many other articles have been described and recommended. The first essential is a glass-legged stool, Fig. 3; if required for cheapness it may be a piece of board, made smooth, and with round edges, supported upon four wine bottles, pegs being driven into the under-side of the board to fit the necks of the bottles; solid glass legs are, how-

ever, infinitely better. In using the stool, a large sheet of brown paper or pasteboard; or, still better, a piece of oil-cloth, larger than the stool itself, is to be placed beneath it on the floor, to prevent the filaments of the carpet, or the dust of the floor, from drawing away any of the fluid accumulated.

The next requisite is a flexible tube or connector; as a chain must necessarily have many edges or points, the stool should be connected to the machine by a chain which is sewed up in silk, and afterwards varnished or covered with India rubber; thus there will be no loss of fluid. But for numerous purposes the instrument called a flexible tube is much better. This is seen in Fig. 4 of our cut: it consists of a joint at the top, one part of the joint having a peg projecting from it, which fits into the hole at the top of the conductor; the other part has a metal tube about a foot long, attached to it. A round knob of wood closes this tube at the lower end, and a covered chain passes through the knob, and into a second knob belonging to a second joint of metal. A third joint is attached in the same manner. The outer end of this has a screw to it, by which it may be fastened to the electrical stool, as shown in the cut; or it may be by this means showed to the point, No. 6; or to a ball, as shown in No. 5, for purposes hereafter mentioned; when wanted for these uses, a wooden band is placed upon the last joint, to which a glass handle may be fitted.

The wooden point is seen at Fig. 6, which representation is about $\frac{3}{4}$ its proper size. It should have a screw at the thicker end, to fit the end of the flexible tube, and the point of it is not to be sharp. A metal point of the same shape and size is sometimes used, but we have found it not so gentle in drawing off the fluid from a patient as one of box-wood. By the point a gentle stream of electricity, called the electrical aura or breeze, is given to or taken from a patient, according as the point is held in the hands of the operator, (the patient being on the electrical stool,) or attached to the glass-handled flexible tube; the patient being on the ground, or rather not *insulated*. These simple instruments, with the exception of a wire with a brass ball at the end of it, are all that are necessary for the administration of the electric fluid. When shocks are to be given, a Leyden jar is indispensable—any Leyden jar may be used, but the one shown in Fig. 7 is that best adapted for medical purposes. The jar is exhibited as hanging to the projecting knob of the prime conductor of a machine, and having other apparatus attached to it. The medical jar here mentioned and represented is a bottle of about a quart in capacity; a size quite sufficient for every purpose. It is like an ordinary Leyden jar, covered and lined to a certain height with tin-foil. A wooden cap is then prepared for it, and a hole just admitting a glass tube is bored in the middle of the cap. The tube reaches below to within 2 inches of the bottom, and projects upwards above the cap, about 3 inches. It is also lined and covered with tin-foil, so placed that rather more than an inch of the glass is left uncovered at the lower end, and about 2 inches at the upper end. The tube is cemented to the top of the bottle, and a smaller cap cemented on the top of the glass tube; but before this last is cemented on, three hooks are drilled in it; one for a hook wherewith to suspend the phial from the conductor, the two others are to be left open; one of them to admit a wire to touch the inner coating of the tube, the other a second wire, sufficiently long to reach to the coating of the phial—these are shown in the cut.

at A and B. A wire is also twisted round the outer coating of the inner tube, which projects outwards sufficiently to touch the inner coating of the phial. On the outer coating of the phial is fastened a hook, marked C, for the convenience of attaching a chain.

Fig. 8 is a medical electrometer; its use is to regulate the strength of the shock, for this depends upon the intensity with which the phial is charged, no less than the size of the phial itself. H is a smooth piece of wood, shaped like a boy's top, or when made of metal it is merely a socket, and a wire attached to it laterally. Into this socket is cemented a bent glass tube G; at the opposite end of this is a second socket of wood or metal, also cemented to the glass. A hole is made through this socket to admit the wire, which holds the brass balls E and F. This wire is capable of sliding backwards and forwards, parallel with the horizontal part of the glass tube. D is supposed to be a knob of the prime conductor. When in use, to the outer ball F or the electrometer, and also to the hook C of the bottle, are attached chains, leading to a pair of glass-handled directors; the upper part of which is seen in the cut No. 10, and a director complete at Fig. 9.

We will now show the use of this apparatus. The directors are for two purposes; first, that by means of their balls they shall be able to direct the fluid, or shock, to any particular part only, and confine it thereto, as in the following cut; the shock may be given from the knee to the foot without its affecting the rest of the body.



The use of the glass handles is to prevent the operator from participating in the shock he intends for his patient. The operator, of course, holds the glass handles, while the balls are made to touch the extreme points of that line through which the shock is to pass. One director is usually straight, as is seen in those at Fig. 10; the other bent as in Fig. 9. We will now suppose that the ball E of the electrometer has been placed so as to touch the ball D, (the whole apparatus being dry, and in good working order;) and indeed that the whole is as represented in the cut; the knobs of the directors touching, and the wires A and B being in their place. Turn the machine, and the bottle will not charge, because the outside is in close contact with the inside, there being no interruption in the circuit anywhere. Now remove the ball E a short space from D; upon turning the machine a second time, the bottle will become charged, because its inside is not connected by conducting substances with its outside. A vacancy occurs between D and E, and exactly in proportion to the size of that vacancy will be the strength of the shock which passes through the chains, or the

balls of the directors; and as those balls are applied to different parts of the body, so of course will be the strength of the shock which will be felt. The above supposes that both wires are in the bottle; now if we draw out the longer wire, the only one left will be that which touches the inner coating of the tube, and this tube being so small, the shocks which will pass will be less energetic than those given by the larger bottle, and will altogether have a different character. They are, indeed, intermediate in effect between sparks and shocks, and are called *vibrations*.

Fig. 2 in the cut shows the usual method of administering a shock through a number of persons at once, supposing we have not the apparatus above described, and that we desire only amusement. The phial on the table is charged; a chain connects its outside to the first person, he by joining hands to the second, and so on to the end; the last person touching the knob of the phial with a wire and ball. If the persons shocked turn their backs to the phial, the shock will reach them more unexpectedly. The peculiar application of the above apparatus to the cure of disease will form the subject of another paper.

LOGWOOD.

(Resumed from page 264, and concluded.)

IN the treaty of Utrecht, in 1713, the commercial relations of the two countries in America were not again neglected, and at length the privilege of cutting logwood was confirmed to the English in plain and express terms, so that it was supposed the question was set at rest for ever. It, however, still continued to be a subject of constant dispute between the parties, and, in 1717, the Marquis de Monteleone, then Spanish ambassador extraordinary at the court of St. James's, delivered a memorial to the British government against the settlements in the isle of Trist, and at Laguna de Terminos in the bay of Campeachy, declaring that if in the space of eight months these places were not evacuated, the inhabitants should be considered and treated as pirates. This document was submitted to the Board of Trade in England, which after much investigation, came to the decided opinion that British subjects were entitled to cut wood in the bay of Campeachy. Spain reluctantly acquiesced in this positive decision, and the settlement continued without being matter of farther dispute or treaty for more than forty years. During this long period the British settlers had not been idle. Fortifying themselves against the assaults of the Spanish Americans, their colony assumed a more important and imposing aspect, not only having the power to resist but to resent aggression. These defensive measures were naturally viewed with alarm by the Spaniards, and in a treaty concluded in 1763, the two countries came to a compromise on this question; the English government consenting that the fortifications erected in the bay of Honduras, and other Spanish territories in America, should be demolished; while the Spanish government engaged that the subjects of Great Britain should not be molested in cutting or shipping logwood.

Notwithstanding the above treaty the Governor of Yucatan in the ensuing year gave great annoyance to the British logwoodcutters in Campeachy Bay, and even drove them from the place on the pretext that they had no certificate to prove them British subjects, and that, moreover, they made too

free with the produce of the country. No time was lost in remitting a remonstrance to the Spanish court, which unreservedly disavowed and disapproved of the conduct of the governor. Positive orders were sent out to that man of office, and the English once more obtained their logwood without molestation. They were not, however, allowed to remain long undisputed occupiers of this coast. The French now attempted to supplant, or to share with them in this lucrative employment, and invaded their privilege by cutting logwood on those parts of the coast the productions of which had been assigned to the English by the last treaty. Although this had forbidden them to raise fortifications, it had at the same time not only given to them the right of cutting and shipping logwood, but of erecting houses and magazines, together with the privilege of a free fishery in the adjacent seas, on that part of the coast of the bay of Honduras, which was comprehended between the river Wallis on the south side, and the Rio Nuevo and the Rio Hohdo on the north side; the sovereignty of the country still remaining with Spain. The privileged settlers of Campeachy of course treated the French as intruders, and were forced again to contend for the right of being undisputed wood hewers in a tropical morass.

The logwood-tree is of very rapid growth and easy of propagation, so that in a few years a flourishing plantation may be formed. It thrives best in marshy ground; but this ground must not be always under water. Trees of full growth are from sixteen to twenty-four feet in height, and sometimes five or six feet in circumference. The stems are in general very crooked and deformed; the bark is in young trees white and smooth, but blackish and rough in old ones; irregular branches armed with strong thorns shoot forth on every side. The shiny bright green leaves are winged, having three pair of lobes indented at the top. The flowers grow in clusters, springing from the axils of the leaves. They are of a very pale yellow hue, with a purple empalement. Dampier and others were struck with the resemblance the logwood-tree bears to our beautiful and fragrant hawthorn.

The logwood-tree grows abundantly throughout whole districts in Jamaica. Besides being cultivated as a dye-wood it is used for other purposes. It is found well adapted for making strong full hedges, and is constantly planted for this purpose, no other fences being seen in many parts of the island. It is excellent for fuel, and, according to Dampier, is advantageously used in hardening or tempering steel. The wood of this tree is very hard and heavy; it is of a deep orange red color; it yields its color both to aqueous and spirituous menstrua, but the latter extracts it the most readily and copiously. A decoction of this wood is of a deep violet or purple color, which after a time changes to a yellowish tint, and becomes finally black. Like that of Brazil-wood, it is made yellow by acids and deepened by alkalis. Although an adjective dye, it can be made very durable by the judicious application of mordants. With alum and tartar it produces a violet dye. With acetate of copper, a fine blue. But its principal use is in dyeing black, to which it gives a superior lustre, and in the production of all the different shades of grey. It contains a large proportion of gallic acid, whence it is that in combination with acetate of iron, the black is produced.

DIFFERENT KINDS OF VESSELS.

(Resumed from page 261, and concluded.)

We gave on page 260 the commencement of a series of cuts on the different kinds of ships and other vessels. We now continue the subject on those of a smaller class, particularly such as have but a single mast, or which are usually without any. Small vessels like this are mostly employed as coasting vessels, or as pleasure boats, or fishing boats. The first we shall mention is the largest of the Dutch fishing boats, and which we have before alluded to under the name of *Dutch Schuyt*. In the river Thames hundreds of these are constantly to be seen, having conveyed to our market, not merely ordinary merchandise, but particularly the fish caught off the Dutch coast, such as lobsters and cod fish; salted herrings are also brought over in immense quantities in the Schuyt. Their great breadth of beam renders them, as it does also the Galliot, as before observed, excellent sea boats, and capacious as vessels for merchandise. The Schuyt is seen beneath:—



A *Hog Boat* is a strong and capacious sea boat, used almost wholly for fishing, and common around the southern and eastern coasts, particularly at Brighton and at Yarmouth. It draws very little water, and hence is used over the flat beaches. It is furnished with one mast, and boom with triangular sails; one of which is hoisted up by rings along the stays, the other by rings along the mast.



Another Yarmouth boat is seen in the next illustration; it is called *Yarmouth Cobles*—its purpose is also for fishing. It has a lug sail, and the boat itself is square both at the head and stern; to the latter of which two ropes are fastened to hold the anchor.



It would seem scarcely necessary to allude to the *Peter Boat*, it being so common as to be generally known. It is worked along both by oars, and by sails. The particular character of the rigging is easily understood by the cut, which shows the sails furled, or taken in.



A *Pilot Boat* is necessarily a quick sailer, and of equal necessity adapted to the roughest sea, such an one is represented beneath. Its hull is small in proportion to its sails, the main of which is suspended from a gaff above, and is held merely by a line beneath, there being no boom, as in so small a vessel such would be inconvenient and dangerous.



A *Fishing Smack* is seen below, and we cannot help being pleased with seeing these pretty little, active vessels, when scudding before the wind at the mouth of our rivers, or when at anchor in whole fleets waiting for the tide, or for their finny cargo. The smack is usually rigged like the cutter, and is one of the fastest vessels.



What the smack is for fishing, the *Yacht* is for pleasure, except that the yacht has a top-mast and top-sail, though this is not always a criterion. Yachts are for the conveyance of passengers, and are therefore fitted up for elegant comfort and convenience. They are the vessels used for the conveyance of ambassadors and other great personages from one kingdom to another; that which is peculiarly reserved for the conveyance of the sovereign is usually rigged like a ship.



We shall conclude this very brief account of English vessels with a representation of the *Wherry*, having alluded to a different kind of wherry in the last paper on this subject. The wherry we would now direct attention to is that ordinarily used for the passage of rivers, and for pleasure parties upon them. It will be at once recognized by the cut beneath.



We are perfectly aware that the above account of vessels is very imperfect; but the fact is, we cannot find a representation of others which there may be, but if our friends will send us pictures of the yawl, hoy, gun boat, cutter, peragua, scollop, Moses boat, pinnace, launch, birgantine, bilander, &c., we will endeavour to render the subject more complete.

CORN AND CORN MILLS.

(Resumed from page 263, and concluded.)

THE peculiar quality of the Buhr stones, when put into a good face by a skilful miller, is to produce a greater quantity of fine flour from a given quantity of wheat, and of a better color, than other mill-stones. If the grinding has been properly performed, the meal, as it falls from the stones, has a peculiar soft silky feel when rubbed between the fingers, whilst the bran is in the form of large flakes, completely stripped of flour. When the stones are in bad face the bran is cut, and some of it so comminuted as to pass the bolting cloths along with the flour, and thus injure its color. More or less, also, of the meal adheres to the larger pieces of bran and is lost; and another portion, instead of being reduced to an impalpable powder, is only granulated. This latter, when separated from the fine flour by the dressing machine, is called sharps, and must be either sold at an inferior price, or be ground a second time.

The best velocity for stones, 4 feet 2 inches in diameter, is 120 revolutions in a minute; for smaller stones a greater number of revolutions, and for larger ones a smaller number; so that the velocity of the circumference in all shall be nearly equal. The rate of feeding, or the quantity of meal produced, is much influenced by the state of the corn; the drier this is, the closer the stones may be set, and the greater velocity may be given to them. A pair of stones, 4 feet 6 inches in diameter, and running 130 rounds in a minute, have been known to grind in an hour 22 bushels of kiln-dried wheat, and from 6 to 9 bushels of wheat very dry, but not kiln-dried. Stones, 4 feet 2 inches in diameter, and running 120 rounds in a minute, will grind about five bushels in an hour of good dry wheat; but many of the millers in the neighbourhood of London, from fear of over-heating their meal, have reduced the produce to $2\frac{1}{2}$ or 3 bushels per hour. A horse, while at work, will grind at the rate of a bushel an hour, but will not be able to labor more than 6 hours out of 24.

A well-constructed watermill, with an effective fall of 10 feet, will grind one bushel per hour, by an expenditure of about 52 cubic feet of water per minute employed on a breast-wheel: if dressing the meal be added to the grinding, 10 cubic feet more of water will be required. A good steam-engine will grind at the rate of about 10 bushels an hour for every bushel of coals consumed in that time; a peck and a half of coals, therefore, are equivalent, at this work, to the daily labor of a horse.

Sometimes, after every possible care has been taken to suspend the upper stone so that its grinding surface shall in every part be equidistant from the surface of the lower ones, the stones will chatter; that is, the upper one will lose its perfect parallelism with the lower one, and will become oblique; so that on one side the stones will knock against each other, and on the opposite side will be too far apart to make good meal. This is a very serious defect, as it is scarcely possible to remedy it. When at rest, the two stones are correctly parallel, and it is only when in motion that the grinding surface of the runner becomes oblique. To Mr. Donkin we are indebted for a very probable explanation of the phenomenon. From the very irregular size and form of the pieces of Buhr, and from their being cemented together by plaster—a substance that differs much in specific gravity from the Buhr itself—it is

evident that the weight must be very unequally distributed through the mass: the consequence of this will be, that the plane of rotation will never strictly coincide with the horizontal plane, to which, alone, can the grinding surfaces be adjusted; and when these planes differ by a certain angular amount, the runner will come in contact with the bed-stone, in one part of its rotation, and produce chattering. The only very obvious remedy for this evil is great attention to sorting the pieces of Buhr, and to arranging them within the frame of the stone, that the cement required shall be distributed as evenly as possible. The stones work within a box or case, which receives the meal as it escapes from their circumference, and delivers it by a spout into a bin or sack, placed to receive it. The friction produced in the act of grinding always occasions a sensible degree of warmth in the meal. It is known, by experience, that the cooler the meal comes from the stones the better is the flour, and the lighter the bread made of such flour. Meal that has been thus over-heated is technically said to be killed; and it will be produced both when the runner is going too rapidly, and when the mill is fed with corn too quick. While the meal continues warm, the moisture will be exhaling from its interior in vapor, and will be condensed on its surface, making that part of the meal damp, and therefore more likely to be attacked by insects, to become tainted, or mouldy. It is also incapable of being dressed or bolted with so much accuracy as meal of a proper state of dryness is, from the adhesion of the particles to one another. It might be thought, that if the meal fell into the bin from a greater height, and in a more dispersed state, it would be completely cooled; and so, probably, it would; but we know that oatmeal is a very hygrometric substance, and, probably, wheatmeal is so likewise. The consequence, therefore, of cooling it by more free exposure to the air would, probably, be no improvement in dryness, but quite the contrary; and the more the meal had previously been heated, the more hygrometric would it become.

From the receiving-bin the corn is transferred to the cooling-bins, which are at the top of the building; and when it has completely cooled to the temperature of the air, it is dressed. This is performed by passing it through an oblique cylinder, covered with wire-cloth of different degrees of fineness; the finest being at the upper, and the coarsest at the lower, end. For the London market, the coarsest cloth has 45 to 56 wires per inch; the middle has from 56 to 60 wires, and the finest has from 60 to 70 wires. The flour that comes through the latter is put into a cylinder of frame-work, covered with a bolting cloth, and having a rapid rotatory motion given to it. What is thus forced through the interstices in the bolting cloth is the finest flour.

The popular charges against millers and bakers of adulterating flour, whether false or true, become, from time to time, epidemically prevalent; and then all the world runs wild for hand or family mills, as they are called. It is worth while, therefore, to consider what may fairly be expected of such mills. The main object proposed by the use of domestic mills, namely, an unadulterated material for bread, is unquestionably obtained. If the grinding is performed between stones, the meal, although coarse, harsh to the feel, and ill-ground in many respects, from want of the necessary knowledge and attention, which can only be expected of those who are millers by trade, will be sufficiently performed to allow of

most of the bran being separated by the sieve, leaving a flour from which perfectly wholesome, though coarse brown bread may be made. The bran, with a considerable quantity of flour still adherent to it for want of being properly ground, remains; and in private families, resident in town, there exists no use to which it can be applied. When, therefore, the loss in the article of bran and of flour not separable from the bran, is added to the current cost of labor for grinding and the prime cost of the mill itself, it will soon appear at what a price a family so supplied eat their bread; for the labor of the mill is such as not to admit of its being imposed as an extra on the ordinary duties of modern domestic servants. The noise, too, of the grinding, is a nuisance that deserves to be taken into account, unless it can be performed in an outhouse, where the laborer employed being out of inspection, has it in his power to adulterate your wheat with inferior grain, in the same degree as is charged upon the miller.

All the objections that we have just enumerated, apply to the use of steel mills; with this in addition, that, as the action of metal plates is to cut rather than to rub down or grind the grain, a much larger proportion of flour will be left adherent to the bran, and a much larger proportion of this latter will be cut so fine as to pass through the sieve with the flour; the only way, therefore, at all consistent with economy, of employing the meal produced by a steel mill is to use it entire, without any attempt at separating even the bran. We have had bread made of such meal, and, though dark in color, and coarse to the look, it rose, with the usual quantity of yeast, quite as well as home-made bread of finer quality, and was not deficient either in palatableness or in wholesomeness.

SOLAR VOLCANOES.

DR. ALEXANDER WILSON, Professor of Astronomy at Glasgow, published a paper in the "Philosophical Transactions," for 1774, demonstrating that the spots in the sun's disk are real cavities, excavations through the luminous material, which covers the other parts of the sun's surface. One of these cavities he found to be about four thousand miles deep and many times as wide. Some objections were made to this doctrine by M. De la Lande, in the *Memoirs* of the "French Academy," for the year 1776, which however have been ably answered by Professor Wilson, in reply to the "Philos. Trans." for 1783. Keil observes, in his *Astronomical Lectures*. "We frequently see spots in the sun which are larger and broader not only than Europe or Africa, but which even equal, if they do not exceed the surface of the whole terraqueous globe." Now that these cavities are made in the sun's body by a process of nature similar to our earthquakes does not seem improbable on several accounts. 1. Because from this discovery of Dr. Wilson, it appears that the internal parts of the sun are not in a state of inflammation or of ejecting light, like the external part or luminous ocean which covers it; and hence that a greater degree of heat or inflammation, and consequent expansion or explosion may occasionally be produced in its internal or dark nucleus. 2. Because the solar spots or cavities are frequently increased or diminished in size. 3. New ones are often produced. 4. And old ones vanish. 5. Because there are brighter or more luminous

parts of the sun's disk, called *facule* by Scheiner and Hevelius, which would seem to be volcanoes in the sun, or, as Dr. Wilson calls them, "eructations of matter more luminous than that which covers the sun's surface." 6. To which may be added that all the planets added together with their satellites do not amount to more than one six hundred and fiftieth part of the mass of the sun according to Sir Isaac Newton.

Now if it could be supposed that the planets were originally thrown out of the sun by larger sun-quakes than those frequent ones which occasion these spots or excavations above mentioned, what would happen? 1. According to the observations and opinion of Mr. Herschel the sun itself and all its planets are moving forwards round some other centre with an unknown velocity, which may be of opaque matter, corresponding with the very ancient and general idea of a chaos. Whence if a ponderous planet, as Saturn, could be supposed to be projected from the sun by an explosion, the motion of the sun itself might be at the same time disturbed in such a manner as to prevent the planet from falling again into it. 2. As the sun revolves round its own axis its form must be that of an oblate spheroid like the earth, and therefore a body projected from its surface perpendicularly upwards from that surface would not rise perpendicularly from the sun's centre, unless it happened to be projected exactly from either of its poles or from its equator. Whence it may not be necessary that a planet if thus projected from the sun by explosion should again fall into the sun. 3. They would part from the sun's surface with the velocity with which that surface was moving, and with the velocity acquired by the explosion, and would therefore move round the sun in the same direction in which the sun rotates on its axis, and perform elliptic orbits. 4. All the planets would move the same way round the sun, from this first motion acquired at leaving its surface, but their orbits would be inclined to each other according to the distance of the part, where they were thrown out, from the sun's equator. Hence those which were ejected near the sun's equator would have orbits but little inclined to each other, as the primary planets; the plain of all whose orbits are inclined but 7° and a half from each other. Others which were ejected near the sun's poles would have much more eccentric orbits, as they would partake so much less of the sun's rotatory motion at the time they parted from his surface, and would therefore be carried further from the sun by the velocity they had gained by the explosion which ejected them, and become comets. 5. They would all obey the same laws of motion in their revolutions round the sun; this had been determined by astronomers, who have demonstrated that they move through equal areas in equal times. 6. As their annual periods would depend on the height they rose by the explosion, these would differ in them all. 7. As their diurnal revolutions would depend on one side of the exploded matter adhering more than the other at the time it was torn off by the explosion, these would also differ in the different planets, and not bear any proportion to their annual periods. Now as all these circumstances coincide with the known laws of the planetary system, they serve to strengthen this conjecture.

This coincidence of such a variety of circumstances induced M^{de} Buffon to suppose that the planets were all struck off from the sun's surface by the impact of a large comet, such as approached so near

the sun's disk, and with such amazing velocity in the year 1680, and is expected to return in 2255. But Mr. Buffon did not recollect that these comets themselves are only objects with more eccentric orbits, and that therefore it must be asked, what had previously struck off these comets from the sun's body? 2. That if all these planets were struck off from the sun at the same time, they must have been so near as to have attracted each other, and have formed one mass. 3. That we shall want new causes for separating the secondary planets from the primary ones, and must therefore look out for some other agent, as it does not appear how the impulse of a comet could have made one planet roll round another at the time they both of them were driven off from the surface of the sun.

If it should be asked, why new planets are not frequently ejected from the sun? It may be answered, that after many large earthquakes many vents are left for the elastic vapors to escape, and hence, by the present appearance of the surface of our earth, earthquakes prodigiously larger than any recorded in history have existed, the same circumstances may have affected the sun, on whose surface there are appearances of volcanoes, as described above. Add to this, that some of the comets, and even the Georgium Sidus, may, for ought we know to the contrary, have been emitted from the sun in more modern days, and have been diverted from their course, and thus prevented from returning into the sun, by their approach to some of the older planets, which is somewhat countenanced by the opinion several philosophers have maintained, that the quantity of matter of the sun has decreased. Dr. Halley observed, that by comparing the proportion which the periodical time of the moon bore to that of the sun in former times, with the proportion between them at present, the moon is found to be somewhat accelerated in respect to the sun. And so large is the body of this mighty luminary, that all the planets thus thrown out of it would make scarce any perceptible diminution of it, as mentioned above. The cavity mentioned above, as measured by Dr. Wilson of 4000 miles in depth, not penetrating an hundredth part of the sun's semi-diameter; and yet, as its width was many times greater than its depth, was large enough to contain a greater body than our terrestrial world.

We do not mean to conceal, that from the laws of gravity unfolded by Sir Isaac Newton, supposing the sun to be a sphere, and to have no progressive motion, and not liable itself to be disturbed by the supposed projection of the planets from it, that such planets must return into the sun. The late Rev. William Ludlam, of Leicester, after having shown, as mentioned above, that planets so projected from the sun would return to it, adds, "That a body like the moon so projected, would disturb the motion of the earth in its orbit, is certain; but the calculation of such disturbing forces is difficult. The body in some circumstances might become a satellite, and both move round their common centre of gravity, and that centre be carried in an annual orbit round the sun."

There are other circumstances which might have concurred at the time of such supposed explosions, which would render this idea not impossible. 1. The planets might be thrown out of the sun at the time the sun itself was rising from chaos, and be attracted by other suns in their vicinity rising at the

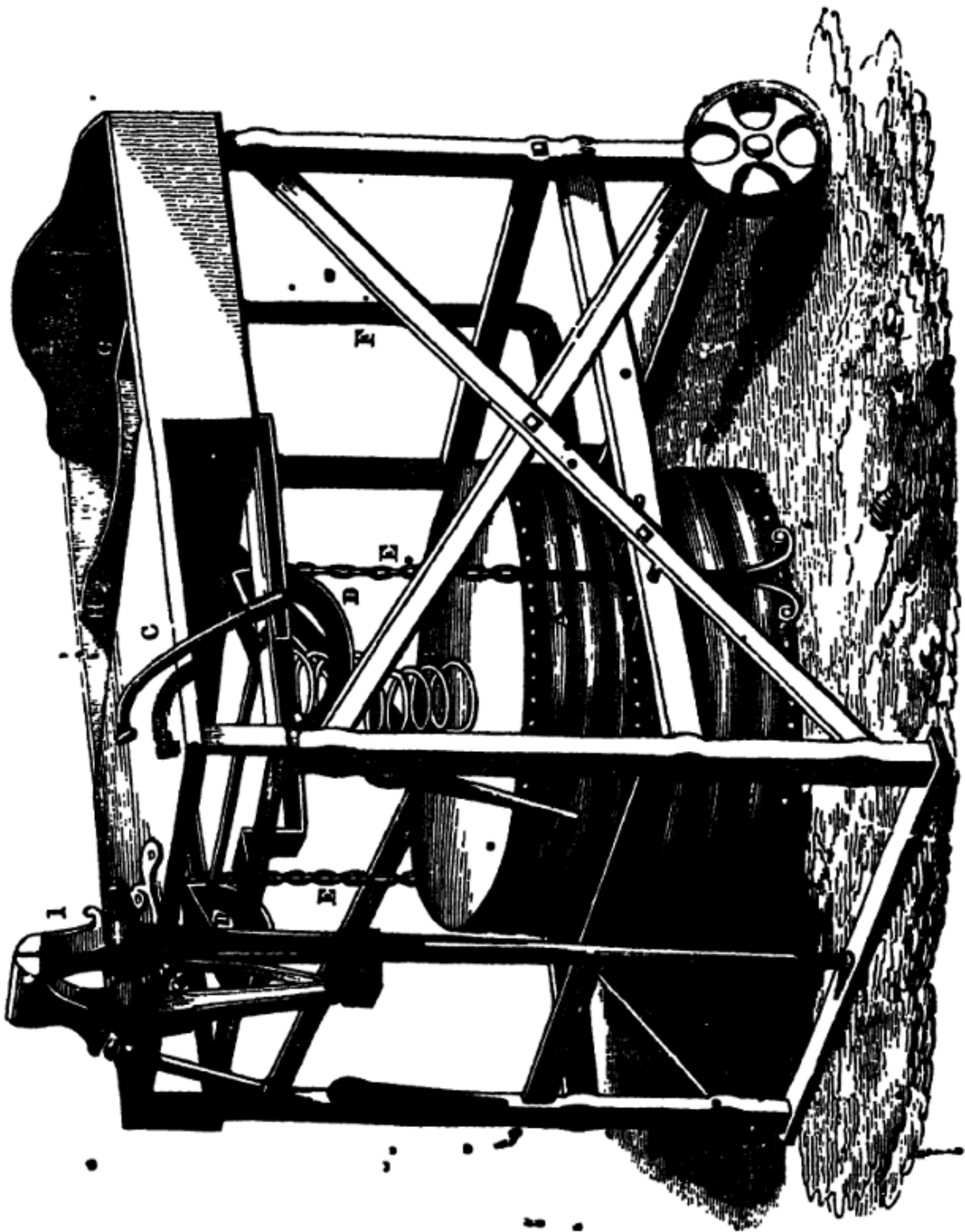
same time out of chaos, which would prevent them from returning into the sun. 2. The new planet in its course or ascent from the sun, might explode and eject a satellite, or perhaps more than one, and thus by its course being affected might not return into the sun. 3. If more planets were ejected at the same time from the sun, they might attract and disturb each other's course at the time they left the body of the sun, or very soon afterwards, when they would be so much nearer each other.

MEMORANDA.

Singular Heat developed in the Fusion of Tin and Platinum.—A very extraordinary heat is developed by fusing together platinum and tin in the following manner:—If a small piece of tin foil is wrapped in a piece of platinum foil of the same size, and exposed upon charcoal to the action of a blow-pipe, the union of the two metals is indicated by a rapid whirling, and by an extreme brilliancy in the light which is emitted. If the globule thus melted is allowed to drop in a basin of water, it remains for some time red hot at the bottom; and such is the intensity of the heat, that it melts and carries off the glaze of the basin from the part on which it happens to fall.

Steam-baked Bread.—It has been known for some time at Vienna, that if the hearth of an oven be cleared with a moistened wisp of straw, bread baked therein immediately afterwards presents a much better appearance, the crust having a beautiful yellow tint. It was thence inferred that this peculiarity must be attributed to the vapor, which being condensed on the roof of the oven, fell back on the bread. At Paris, in order to secure with certainty so desirable an appearance, the following arrangement is practised:—The hearth of the oven is laid so as to form an inclined plane, with a rise of about 11 inches in three feet, and the arched roof is built lower at the end nearest the door, as compared with the furthest extremity. When the oven is charged, the entrance is closed with a wet bundle of straw. By this arrangement the steam is driven down on the bread, and a golden-yellow crust is given to the bread, as if it had been previously covered with the yolk of an egg.

Remarks on the detection of Metallic Arsenic for Judicial Proceedings. By Professor Otto.—In order to show the separation of arsenic from the contents of the stomach by different methods, I once directed that a grain of arsenious acid should be added to a mixture of egg and potatoes. This poisonous mass was boiled with a ley of potassa, and, after solution had ensued, acidulated with muriatic acid, as had been recommended, for the purpose of separating, so far as possible, organic matter, previous to the general diffusion of the admirable method of Mr. Marsh. The precipitate, however, produced by sulphuretted hydrogen in the filtered acid solution, did not contain any arsenic. The reason of this was soon discovered. By the action of potassa on the white of egg and similar proteine bodies, sulphuret of potassium, as is well known, was produced; this being decomposed by the acid, the metallic arsenic of the arsenious acid had been disengaged by the sulphuretted hydrogen in the form of sulphuret of arsenic. This method is therefore inapplicable.



BURBIDGE AND HEALY'S PORTABLE FORGE.

• PORTABLE FORGE.

AMATEUR mechanics in the country have not always the means of procuring those small articles of metal which their models and apparatus may require; and if there are some things more difficult than others to procure, they are small forged articles of iron and steel. In a new machine or invention, particularly if a model of it is to be made, it is astonishing how astute are ordinary workmen, clever perhaps in other respects, in the making of forged articles by pattern. Nine out of ten times, such will be too big or too little, too long or too short, or of a wrong curvature. If even after numerous trials, it should assume the shape and dimensions required, yet the inventor will not always find it what it should have been; a first suggestion is generally improvable—and often alteration upon alteration is requisite—all attended with expense, vexation and delay. All this might be prevented by the mechanic having a small portable forge, and with the intention of showing a convenient form for such a useful instrument is the object of the present paper and its illustrative cut. The portable forge here shown is that made by Messrs. Burbidge and Healy, of Fleet-street. The account of its adaptations are described by them as follows:—"This forge answers all the purposes of the ordinary smith's forge. More particularly adapted to the use of ships going long voyages, being very light, occupying little space, may be unscrewed, taken to pieces, and stowed away until wanted. It would also be found useful for new colonies, mechanical gentlemen, engineers, smiths, &c. for out-door work. Height, 2 feet 6 inches; length, 2 feet 9 inches; width, 2 feet; weight, only 2 cwt." We will endeavour to supply the description of the working parts of this machine, in aid of the above very meagre account. A is the bellows, formed of two parts in the usual method of the double forge bellows, but of a round form. This is attached to the two horizontal side bars by its centre board. B is a spiral spring which constantly presses upon the upper board of the bellows, producing a constant and equable blast of air when the machine is at work. C is a handle. D D two arcs of iron fixed to that handle, and connected together by a horizontal bar running across the frame. To the two arcs are connected chains E E, and these are at their lower ends attached to upright bars of iron. The division H is for holding coals. The space between that and the vice I is for resting the tools—and the part G is where the fire is to be kindled. There are two wheels at the bottom of one end of the machine, that it may easily be removed from place to place; and the front end is made without wheels that the whole may stand steadily. When the handle C is moved backward, and forwards, the chains are drawn up and down, filling the bellows—the air thus collected in them is forced out by the spring B, through the pipe F, to the tuyer or hole G, where it plays upon the fire.

SHOWERS OF BLOOD AND RED SNOW.

It is not a little remarkable, that when insects are evolved from the pupa state, they always discharge some substance. It is important to remark, that the matter voided at this period by many butterflies (*Vaneise*, &c.) is of a red color, resembling blood, while that of several moths is orange or whitish. It could not readily be supposed that this should become the object of superstitious terror, yet so it

has been in more instances than one. Mouffet tells us, from Sleidan, that in the year 1553 a prodigious multitude of butterflies swarmed throughout a great portion of Germany, and sprinkled plants, leaves, buildings, clothes, and men, with bloody drops, as if it had rained blood. Several historians, indeed, have recorded showers of blood among the prodigies which have struck nations with consternation, as the supposed omen of the destruction of cities and the overthrow of empires. About the beginning of July, 1608, one of these showers of blood was supposed to have fallen in the suburbs of Aix, and for many miles around it, and particularly the walls of a churchyard were spotted with the blood. This occurrence would, no doubt, have been chronicled in history as a supernatural prodigy, had not Aix possessed at this time, in M. Peiresc, a philosopher, who, in the eager pursuit of all kinds of knowledge, had not neglected the study of insects. It is accordingly related, in the curious life of Peiresc by Gassendi, that he had, about the time of the rumoured shower of blood, happened to find a large *chrysalis*, the beauty of which made him preserve it in a box. Some time after, hearing a noise in the box, he opened it and found a fine butterfly, which had left upon the bottom a red stain of considerable magnitude, and apparently of exactly the same nature with the drops on the stones, popularly supposed to be blood. He remarked, at the same time, that there were countless numbers of butterflies flying about, which confirmed him in the belief of his having discovered the true cause; and this was further corroborated by his finding none of the red drops in the heart of the city, where the butterflies were rarely seen. He also remarked, that the drops were never on tiles and seldom on the upper part of a stone, as they must have been had they fallen from the heavens, but usually appeared in cavities and parts protected by some angular projection. What Peiresc had thus ascertained, he lost no time in disclosing to many persons of knowledge and curiosity, who had been puzzling themselves to account for the circumstance by far-fetched reasonings, such as a supposed vapour which had carried up a supposed red earth into the air that had tinged the rain;—no less wide of the truth than the popular superstition which ascribed it to magic, or to the devil himself. Those who are curious to verify the discovery, as we may well call it, of Peiresc, may easily do so by rearing any of the spinous caterpillars which feed on the nettle till they are transformed into the butterfly. We have witnessed the circumstance in innumerable instances.

It is a curious and interesting probability, that the crimson snow of the Alpine and Arctic regions, which has recently excited so much scientific inquiry, should be referable to a somewhat similar cause,—a circumstance which will apologize for our taking some notice of it here by way of illustration. According to Professor Agardh, red snow is very common in all the alpine districts of Europe, and is probably of the same nature with that brought from the polar regions by Captain Ross. Saussure saw it in abundance on Mont Brevern, in Switzerland, and elsewhere; Ramond found it on the Pyrenees; and Sommerfeldt in Norway. In March, 1808, the whole country about Cadone, Belluno, and Feltri, is reported to have been covered in a single night with rose-colored snow; and at the same time a similar shower was witnessed on the mountains of Valtellin, Brescia, Carinthia, and Tyrol. But the most remarkable red snow shower was that which

fell on the night between the 14th and 15th of March, 1823, in Calabria, in Abruzzo, in Tuscany, at Bologna, and through the whole chain of the Apennines.

Upon the return of Captain Ross from the Polar expedition some years ago, the specimens of red snow which he brought home were examined by three of our most distinguished observers, Wollaston, Bauer, and Robert Brown, who all came to the conclusion that it was of a vegetable nature, but differed as to its botanical characteristics. Dr. Wollaston supposed it to be the seed of some moss; Mr. Brown was inclined to consider it an algæ, related to *Tremella cruenta*, a common native plant; while Mr. Bauer thought it was a fungus of the genus *Uredo*. Professor Agardh refers it with Brown to the lowest order of algæ, but standing as a distinct genus upon the very limits of the animal and vegetable kingdoms. Saussure, indeed, from finding that the red snow of the Alps gave out, when burnt, a smell like that of plants, concluded that it was of vegetable origin, and supposed it to consist of the farina of some plant, though he could not trace it to its source. Baron Wrangel, again, who discovered a production similar or identical with Agardh's *Protococcus nivalis* growing upon limestone rocks, mentions that it was easily detached when placed under water, and in three days it was converted into animated globules like infusory animalcules, which swarm about and were made prey of by other infusoria. Professor Nees von Esenbeck, of Bonn, is inclined to think that the minute red globules, of which the *Protococcus* consists, are the vegetable state of bodies which had gone through a previous animal existence.

The Rev. W. Scoresby, on the other hand, conjectures that the red color of the snow may be traced to the same cause as the orange-colored ice of the polar seas, which arises from innumerable minute animals belonging to the *Radiata*, and similar to the *Beroë globulosa* of Lamarck. It is about the size of a pin's head, transparent, and marked with twelve brownish patches of dots. In olive-green sea water, he estimated 110,592 of these in a cubic foot.

Agardh remarks, that it is agreed upon all hands that the crimson snow always falls in the night, from which he infers that it has not been actually seen to fall. He thinks it is called into existence by the vivifying power of the sun's light, after its warmth has caused the snow to dissolve, accompanied by the incomprehensible power in white snow of producing a color.

Reaumur says, with much justice, on another occasion, that an ordinary spectator frequently discovers what has escaped the notice of the best observers, and so it should seem it has happened in the present case,—the learned naturalists just mentioned having gone as wide of the facts, as the philosophers at Aix in accounting for the supposed shower of blood. Mr. Thomas Nicholson, accompanied with two other gentlemen, made an excursion the 24th July, 1821, to Sossallick Point, near Bushman's Island, in Prince Regent's Bay, in quest of meteoric iron. "The summit of the hill," he says, "forming the point, is covered with huge masses of granite, whilst the side which forms a gentle declivity towards the bay was covered with crimson snow. It was evident, at first view, that this color was imparted to the snow by a substance lying on the surface. This substance lay scattered here and there in small masses, bearing some resemblance to

powdered cochineal, surrounded by a lighter shade, which was produced by the coloring matter being partly dissolved and diffused by the deliquescent snow. During this examination our hats and upper garments were observed to be daubed with a substance of a similar red color, and a moment's reflection convinced us that this was the excrement of the little auk, (*Uria alle, Temmick*,) myriads of which were continually flying over our heads, having their nests among the loose masses of granite. A ready explanation of the origin of the red snow was now presented to us, and not a doubt remained in the mind of any that this was the correct one. The snow on the mountains of higher elevation than the nests of these birds was perfectly white, and a ravine at a short distance, which was filled with snow from top to bottom, but which afforded no hiding-place for these birds to form their nests, presented an appearance uniformly white."

This testimony seems to be as clear and indisputable as the explanation given by Peisec of the ejecta of the butterflies at Aix. But, though it will account, perhaps, for the red snow of the polar regions, it will not explain that of the Alps, the Apennines, and the Pyrenees, which are not, so far as we know, visited by the little auk. Another conjecture of the origin of red snow is that it is of a vegetable nature; to this we shall refer on a subsequent occasion.

TAKING CASTS OF ANIMALS, &c.

PREPARE a box sufficiently large to hold the animal, in which it must be suspended by a string; the legs, wings, &c. of the animal, or the tendrils, leaves, &c. of the vegetable, must be separated and adjusted in their right position by a pair of pincers. A due quantity of plaster of Paris, mixed with talc, must be tempered to a proper consistence with water, and the sides of the box oiled. Also a straight piece of stick must be put to the principal part of the body, and pieces of wire to the extremities of the other parts, that they may form, when drawn out after the matter of the mould is set and firm, proper channels for pouring in the metal, and vents for the air, which otherwise, by the rarefaction it would undergo, from the heat of the metal, would blow it out, or burst the mould. In a short time the plaster will set, and become hard; the stick and wires may now be drawn out, and the frame in which the mould was cast taken away; the mould must then be put, first into a moderate heat, and afterwards, when it is as dry as it can be rendered by that degree, removed into a greater, which may be gradually increased until the whole be red hot. The animal or vegetable inclosed in the mould will then be burnt to a coal, and may be totally calcined to ashes by blowing for some time into the charcoal and passages made for pouring in the metal, and giving vent to the air. This operation, at the same time that it destroys the remainder of the animal or vegetable matter, will force out the ashes. The mould is then allowed to cool gently; the destruction of the substance that had been included in it has now produced a corresponding hollow; but it may, nevertheless, be proper to shake the mould, and blow with bellows into each of the air vents, to free it wholly from any remaining ashes; when there may be an opportunity of filling the hollow with quicksilver, it will be found an effectual method of cleaning the cavity, as all the dust and ashes must rise to the surface of the quicksilver, and be poured out with it.

The mould being thus prepared must be heated very hot when used, if the cast is to be made of copper or brass, but a less degree of heat will serve for lead and tin. The metal being poured into the mould, it must be gently struck, and then suffered to rest till it be cold; it is then carefully taken from the cast, but without force. Such parts of the matter as appear to adhere more strongly are to be softened by soaking in water until they be loosened, that none of the more delicate parts of the cast may be broken off or bent. When talc cannot be obtained, plaster alone may be used; it is apt, however, to be calcined by the heat used in burning the animal or vegetable from which the cast is taken, and to become of too incoherent and friable a texture. Stourbridge clay, washed perfectly fine, and mixed with an equal part of fine sand, may be employed. Pounded pumice-stone and plaster of Paris, in equal quantities, mixed with washed clay in the same proportion, make excellent moulds.

CALCAREOUS EARTH,

FROM having observed that many of the highest mountains of the world consist of lime-stone replete with shells, and that these mountains bear the marks of having been lifted up by subterraneous fires from the interior parts of the globe; and as lime-stone replete with shells is found at the bottom of many of our deepest mines, some philosophers have concluded that the nucleus of the earth was for many ages covered with water which was peopled with its adapted animals; that the shells and bones of these animals in a long series of time produced solid strata in the ocean surrounding the original nucleus.

These strata consist of the accumulated exuvise of shell-fish, the animals perished age after age, but their shells remained, and in progression of time produced the amazing quantities of lime-stone which almost cover the earth. Other marine animals called coralloids raised walls and even mountains by the congeries of their calcareous habitations; these perpendicular coralline rocks make some parts of the Southern Ocean highly dangerous, as appears in the journals of Capt. Cook. From contemplating the immense strata of lime-stone, both in respect to their extent and thickness, formed from these shells of animals, philosophers have been led to conclude, that much of the water of the sea has been converted into calcareous earth by passing through their organs of digestion. The formation of calcareous earth seems more particularly to be an animal process as the formation of clay belongs to the vegetable economy; thus the shells of crabs and other testaceous fish are annually reproduced from the mucous membrane beneath them; the shells of eggs are first a mucous membrane, and the calculi of the kidney, and those found in all other parts of our system which sometimes contain calcareous earth, seem to originate from inflamed membranes; the bones themselves consist of calcareous earth united with the phosphoric or animal acid, which may be separated by dissolving the ashes of calcined bones in the nitrous acid; the various secretions of animals, as their saliva and urine, abound likewise with calcareous earth, as appears by the incrustations about the teeth and the sediments of urine. It is probable that animal mucus is a previous process towards the formation of calcareous earth; and that all the calcareous earth in the world which is seen in lime-stones, marbles, spars, alabasters, marls, (which make up the greatest part of the earth's

crust, as far as it has yet been penetrated,) have been formed originally by animal and vegetable bodies from the mass of water, and that by these means the solid part of the terraqueous globe has perpetually been in an increasing state, and the water perpetually in a decreasing one.

After the mountains of shells and other recrements of aquatic animals were elevated above the water the upper heaps of them were gradually dissolved by rains and dews, and oozing through were either perfectly crystallized in smaller cavities and formed calcareous spar, or were imperfectly crystallized on the roofs of larger cavities, and produced stalactites; or mixing with other undissolved shells beneath them formed marbles, which were more or less crystallized and more or less pure; or lastly, after being dissolved, the water was exhaled from them in such a manner that the external parts become solid, and thus chalk was produced.

If this dissolved lime-stone met with vitriolic acid it was converted into alabaster, parting at the same time with its fixable air. If it met with the fluor acid it became fluor; if with the siliceous acid flint; and when mixed with clay and sand, or either of them, acquires the name of marl. And under one or other of these forms composes a great part of the solid globe of the earth. Another mode in which lime-stone appears is in the form of round granulated particles, but slightly cohering together; of this kind a bed extends over Lincoln heath, perhaps twenty miles long by ten wide. The form of this calcareous sand, its angles having been rubbed off, and the flatness of its bed, evince that that part of the country was so formed under water, the particles of sand having thus been rounded, like all other rounded pebbles. This round form of calcareous sand and of other larger pebbles is produced under water, partly by their being more or less soluble in water, and hence the angular parts become dissolved, first, by their exposing a larger surface to the action of the menstruum, and secondly, from their attrition against each other by the streams or tides, for a great length of time, successively as they were collected, and perhaps when some of them had not acquired their hardest state.

This calcareous sand has generally been called ketton-stone and believed to resemble the spawn of fish; it has acquired a form so much rounder than siliceous sand from its being of so much softer a texture and also much more soluble in water. There are other soft calcareous stones called tuffa which are deposited from water on mosses, as at Matlock, from which moss it is probable the water may receive something which induces it the readier to part with its earth. In some lime-stones the living animals seem to have been buried as well as their shells during some great convulsion of nature, these shells contain a black coaly substance within them, in others some phlogiston or volatile alkali from the bodies of the dead animals remains mixed with the stone, which is then called liver-stone, as it emits a sulphurous smell on being struck, and there is a stratum about six inches thick extends a considerable way over the iron ore at Wingerworth near Chesterfield in Derbyshire, which seems evidently to have been formed from the shells of fresh-water muscles.

There is however another source of calcareous earth besides the aquatic one above described, and that is from the recrements of land animals and vegetables as found in marls, which consist of various mixtures of calcareous earth, sand, and clay, all of them perhaps principally from vegetable origin.

Dr. Hutton is of opinion that the rocks of marble have been softened by fire into a fluid mass, which he thinks under immense pressure might be done without the escape of their carbonic acid or fixed air. * If this ingenious idea be allowed it might account for the purity of some white marbles, as during their fluid state there might be time for their partial impurities, whether from the bodies of the animals which produced the shells, or from other extraneous matter, either to sublime to the uppermost part of the stratum or to subside to the lowermost part of it. As a confirmation of this theory of Dr. Hutton's it may be added that some calcareous stones are found mixed with lime, and have thence lost a part of their fixed air or carbonic gas, as the bath-stone, and on that account hardens on being exposed to the air, and mixed with sulphur produces calcareous liver of sulphur. Mr. Monnet found lime in powder in the mountains of Auvergne, and suspected it of volcanic origin.

TENACITY OF TIMBER.

WITH regard to the tenacity or strength of wood, it has been found by Muschenbroëk and other eminent experimentalists, first, that the wood which surrounds immediately the pith or heart of the tree is the weakest, and that this weakness is greater as the tree is older. It is of importance that this fact be known, as a common notion exists of a contrary nature. Secondly, the fibres next to the bark, commonly called the white or blea, are also weaker than the rest; and the wood gradually increases in strength as it recedes from the centre to the blea. Thirdly, the wood is stronger in the middle of the trunk than at the springing of the branches, or at the root; and the wood forming a branch is weaker than that of the trunk. Fourthly, the wood on the northern sides of all trees that grow in Europe is the weakest, while that on the south-eastern side is the strongest; this difference is most remarkable in hedge-row trees, and such as grow singly. The heart of a tree never lies in its centre, but always towards its northern side, and the annual coats of wood are thinner on that side. In conformity with this, it is a general opinion of carpenters that timber is stronger in proportion to the thickness of its annual plates. The trachea, or air vessels, being the same in diameter and number of rows in trees of the same species, occasion the visible separation between the annual plates; for which reason, when these are thicker, they contain a greater portion of the simple ligneous fibres. Fifthly, all woods are most tenacious whilst green, but after the trees are felled, that tenacity is considerably diminished by their drying. By the experiments of Muschenbroëk it appears that the absolute strengths of a square inch of the following different kinds of wood are as stated:—

Locust	20,100	Pomegranate	9,750
Juleb	18,500	Lemon	9,250
Beech and Oak ..	17,300	Tamarind	8,750
Orange	15,500	Fir	8,330
Alder	13,900	Walnut	8,120
Elm	13,200	Pitch pine	7,650
Mulberry & Willow	12,500	Quince	6,750
Ash	12,000	Cypress	6,000
Plum	11,800	Poplar	5,500
Elder	10,000	Cedar	4,800

The woods mentioned were all formed into slips of uniform dimensions, and as much cut away from each, as to form a parallelopiped of one-fifth of an inch, that is, one-twenty-fifth of a square inch in section; and the weights which were required to

tear these asunder, formed the data of the above calculations. Muschenbroëk gives a very minute detail of his experiments on the ash and walnut, in which he states the weights required to tear asunder slips taken from the four sides of these trees, and on each side in a regular progression from the centre to the circumference. The numbers in the foregoing, corresponding with these two woods, may be considered, therefore, as the average of more than fifty trials of each. He mentions, also, that all the other numbers were calculated with the same care. For these reasons some confidence may be placed in the results, though they carry the degree of tenacity considerably higher than those enumerated by some other writers. Pitot and Parent state, that a weight of 60 lbs. will just tear asunder a square line of sound oak, but that it will bear 50 lbs. with safety. This gives 86.40 for the greatest strength of a square inch, or rather less than one-half of Muschenbroëk's estimate; but the latter is, we think, the most entitled to confidence, as the experiments were made upon greater masses of the material. It should, however, be observed, that two-thirds of the actual weight which may be sustained by a body, will greatly impair the strength after a considerable time, and that one-half the absolute tenacity indicated by experiment, should be the utmost that an engineer should calculate upon in his constructions. Woods of the same denomination often differ greatly in their tenacity; those with a very straight fibre suffer less injury from a load that is insufficient to break them immediately. Mr. Emerson mentions the following as the loads which may be safely suspended to an inch square of the several bodies hereafter enumerated; but the term *safely* can hardly apply to the four first-named bodies.

	lbs.		lbs.
Iron	76,400	Red fir, holly, elder,	
Brass	35,600	plane, and crab ..	5,000
Hemp rope	19,600	Cherry and hazel ..	4,760
Ivory	15,700	Alder, asp, hick,	
Oak, box, and yew	7,150	and willow	4,290
Elm, ash, & beech	6,070	Lead	450
Walnut and plum	5,360	Freestone	914

The same ingenious author has laid down as a practical rule, that a cylinder of one inch diameter will carry, when loaded to one-fourth of its absolute strength, as follows:—iron, 135 cwt.; good rope, 22 cwt.; oak, 14 cwt.; and fir, 9 cwt. Parent has shown that the force required to crush a body is nearly equal to that which will tear it asunder. This may be an approximation to the truth as respects woods, but it will not apply to any other bodies. Glass, for instance, will carry a hundred times more on it than oak in this way, but will not bear suspended above four or five times as much. Oak will suspend a great deal more than fir, but fir will carry twice as much as a pillar. Some woods which are very soft, and consequently yield to pressure, possess very strong fibres, and will resist a longitudinal strain. The softness of texture is chiefly owing to the crooked nature of their fibres, and to the existence of considerable vacuities between each fibre, so that they are more easily bent in a lateral direction and crushed. In all cases where the fibres lie oblique to the strain, the strength is considerably diminished, which may be ascribed to the circumstance, that the parts in such case slide on each other, and the connecting force of the cementing matter is for that reason easier overcome. A strain which most commonly acts on materials of any nature, is that which tends to break them in a transverse direction.

THE POTATO AND ITS USES.

THE potato is ascertained to be a native of South America, having been found wild both in Buenos Ayres and in Chili; though Humboldt was very doubtful if that could be proved: he admits, however, that it is naturalized there in some situations. Sir J. Banks considers that the potato was first brought into Europe from the mountainous parts of South America, in the neighbourhood of Quito, where they were called *papas*, to Spain, in the early part of the sixteenth century. From Spain, where they were called *battatas*, they appear to have found their way first to Italy, where they received the same name with the truffle, *taratouffi*. The potato was received by Clusius, at Vienna, in 1588, from the governor of Mons, in Hainault, who had procured it the year before from one of the attendants of the Pope's legate, under the name of *taratouffo*, and learned from him that it was then in use in Italy. In Germany it received the name of *cartoffel*, and spread rapidly even in Clusius's time.

To England the potato was brought from Virginia by the colonists sent out by Sir Walter Raleigh in 1584, who returned in July, 1586, and "probably," according to Sir Joseph Banks, "brought with them the potato." Thomas Hertiot, in a report on the country, published in De Bry's 'Collection of Voyages,' describes a plant called *openak*, with "roots as large as a walnut, and others much larger; they grow in damp soil, many hanging together, as if fixed on ropes. They are good food, either boiled or roasted." Gerard, in his 'Herbal,' published in 1597, gives a figure of the potato, under the name of the potato of Virginia, whence, he says, he received the roots; and this appellation it appears to have retained, in order to distinguish it from the *battatas*, or sweet potato, till the year 1640, if not longer. "The sweet potato," Sir Joseph Banks observes, "was used in England as a delicacy long before the introduction of our potatoes: it was imported in considerable quantities from Spain and the Canaries, and was supposed to possess the power of restoring decayed vigour. The kissing comfits of Falstaff, and other confections of similar imaginary qualities, with which our ancestors were duped, were principally made of these and of eringo roots."

The potato was first planted by Sir Walter Raleigh on his estate of Youghall, near Cork, and Gough says, was "cherished and cultivated for food" in that country before its value was known in England; for, though they were soon carried over from Ireland into Lancashire, Gerard, who had this plant in his garden in 1597, recommends the roots to be eaten as a delicate dish, not as common food. Parkinson mentions, that the tubers were sometimes roasted, and steeped in sack and sugar, or baked with marrow and spices, and even preserved and candied by the comfit-makers. There is a tradition among the peasantry in the county of Galway, that the potato was introduced there previous to its being known in any other part of Ireland, owing to a vessel with some of the roots on board having been wrecked on their coast, and a few of the roots having been roasted by children who found them, they were so much approved of, as to induce the planting of the remainder.

For encouraging the cultivation of potatoes, with the view of preventing famine, the Royal Society took some measures in 1633. Still, however, although their utility as an article of food was better

known, no high character was bestowed on them. In books of gardening, published towards the end of the seventeenth century, a hundred years after their introduction, they are spoken of rather slightly. "They are much used, in Ireland and America as bread," says one author, "and may be propagated with advantage to poor people."—"I do not hear that he hath been essayed," are the words of another, "whether they may not be propagated in great quantities, for food for swine or other cattle." Even the enlightened Evelyn seems to have entertained a prejudice against them: "Plant potatoes," he says, writing in 1699, "in your worst ground. Take them up in November for winter spending; there will enough remain for a stock, though ever so exactly gathered." But the use of potatoes gradually spread, as their excellent qualities became better understood. It was near the middle of the eighteenth century, however, before they were generally known over the country: since that time they have been most extensively cultivated. In 1796, it was found that, in the county of Essex alone, about 1700 acres were planted with potatoes for the supply of the London market. This must form, no doubt, the principal supply; but many fields of potatoes are to be seen in the other counties bordering on the capital, and many ship-loads are annually imported from a distance. In every county in England, it is now more or less an object of field culture.

Potatoes, as an article of human food, are next to wheat, of the greatest importance in the eye of the political economist. From no other crop that can be cultivated will the public derive so much food as from this valuable esculent; and it admits of demonstration, that an acre of potatoes will feed double the number of people that can be fed from an acre of wheat. Potatoes are also a nourishing and healthy food, relished by almost every palate; and it is believed there is hardly a dinner served up for six months in the year without them, in any part of the kingdom.

The varieties of the potato are innumerable: they differ in their leaves and bulk of haulm; in the color of the skin of the tubers; in the color of the interior compared with that of the skin; in the time of ripening; in being farinaceous, glutinous, or watery; in tasting agreeably or disagreeably; in cooking readily or tediously; in the length of the subterraneous stolones to which the tubers are attached; in blossoming or not blossoming: and, finally, in the soil which they prefer.

The produce of the potato varies from five to eight, and sometimes ten to twelve tons per acre. The haulm is of no use but as manure, and is sometimes burned for that purpose, being slow of rotting. The most important application of the potato crop is as human food; on this it is unnecessary to enlarge.

Einhoff found mealy potatoes to contain twenty-four per cent. of their weight of nutritive matter, and rye seventy parts: consequently, sixty-four and a half measures of potatoes afford the same nourishment as twenty four measures of rye. A thousand parts of potato yielded to Sir H. Davy from 200 to 260 parts of nutritive matter, of which from 155 to 200 were mucilage or starch, fifteen to twenty sugar, and thirty to forty gluten. Now, supposing an acre of potatoes to weigh nine tons, and one of wheat one ton, which is about the usual proportion; then as 1000 parts of wheat afford 950 nutritive parts, and 1000 of potato say 230, the quantity of nutri-

tive matter afforded by an acre of wheat and potatoes will be nearly as nine to four; so that an acre of potatoes will supply more than double the quantity of human food afforded by an acre of wheat. The potato is perhaps the "only root grown in Britain" which may be eaten every day in the year without satiating the palate, and the same thing can only be said of the West India yam and bread fruit. They are, therefore, the only substitute that can be used for bread with any degree of success; and indeed they often enter largely into the composition of the best loaf bread, without at all injuring either its nutritive qualities or flavor. In the answer by Dr. Tissot to M. Linquet, the former objects to the constant use of potatoes as food, not because they are pernicious to the body, but because they hurt the faculties of the mind. He owns that those who eat maize, potatoes, or even millet, may grow tall and acquire a large size; but doubts if any such ever produced a literary work of merit. It does not, however, by any means appear that the very general use of potatoes in our own country has at all impaired either the health of body or vigour of mind of its inhabitants.

The manufacture of potato flour is carried on to a considerable extent in the neighbourhood of Paris, and the flour is sold at a price considerably higher than that of wheat, for the use of confectioners and for bakers who prepare the finer sorts of bread. The potatoes are washed and grated, and the starch separated from the pulp so obtained by filtration; it is dried on shelves in a room heated by a fire, and afterwards broken on a floor by passing a cast-iron roller over it. It is then passed through a bolting machine, and put up in sacks for sale.

The meal of potatoes may be preserved for years closely packed in barrels, or unground in the form of slices; these slices having been previously cooked or dried by steam, as originally suggested by Forsyth. Some German philosophers have also proposed to freeze the potato, by which the feculent matter is separated from the starch, and the latter being then dried and compressed, may be preserved for any length of time, or exported with ease to any distance.

The manufacture of tapioca from potatoes is thus given in the "Quarterly Journal of Agriculture." The potatoes selected are thoroughly washed, after which they are grated in a machine constructed for the purpose. The parts thus reduced or grated fall into a vessel placed underneath. From this vessel they are removed, and strained into a tub. On the juice being well expressed for the first time, the fibrous matter is set apart, and cold clean water is thrown over them. These fibres are again put through the same strainer, till the whole of the substance is collected, when they are finally cast aside. On this being done, the contents of the tub, now in a state of mucilage or starch, are allowed to settle. A reasonable interval being suffered to elapse, the old water is poured gently off, and fresh water supplied. After the process of fining and washing, the blanched matter is passed through a smaller strainer. The offals are separated. The starch becomes now much whiter; still fresh water is abundantly dashed over it. When by frequent ablution the surface of this vegetable mass is rendered quite smooth and clean, it is filtrated a third and last time. The strainer now used is of very fine texture, so that no improper or accidental admixture may interfere. As soon as the starch, thus purified, has firmly subsided, it is spread on a board, and exposed to the open air.

The damp speedily evaporates, on which it is, as a security for cleanliness, put through a sieve. A large circular pan is now procured, and set upon the fire. The farina is gradually put into the pan, till what is conceived to be sufficient for one cooking be supplied. As the natural tendency of the farina, in a warm state, is to adhere to the pan, great care is requisite in constantly turning and stirring it. This is effectually done with a broad flat piece of wood, having a long handle to prevent inconvenience from the heat. A temperature of 150° Fah. suits best for perfecting the tapioca. When the farina becomes quite hard, dry, and gritty, it is then ready, and may be taken off the fire.

The ordinary economical applications of the potato, next to those of the culinary and baking arts, are in starch-making and the distillery. Starch is readily made from the scraped and washed tubers cut into small pieces and steeped in water; and a spirit is distilled from mashed potatoes, fermented so as to change a portion of the starch into sugar. In general it is found that 3½ bushels of potatoes afford the same quantity of spirit as one of malt.

Potash may be extracted from potatoe leaves and stalks by the following process:—Cut off the stalks when the flowers begin to fall, as that is the period of their greatest vigour; leave them on the ground eight or ten days to dry, cart them to a hole dug in the earth, about five feet square and two feet deep, and then burn them, keeping the ashes red-hot as long as possible. Afterwards take out the ashes, pour boiling water on them, and then evaporate the water. There remains after the evaporation a dry saline reddish substance, known in commerce under the name of *salin*; the more the ashes are boiled, the greyer, and more valuable the *salin* becomes. The *salin* must be calcined in a very hot oven, until the whole mass presents a uniform reddish brown. In cooling it remains dry, and in fragments bluish within, and white on the surface; in which state it takes the name of potash.

OBTAINING COPPER FROM IRON SPRINGS.

BESIDES the production of copper from the ores of the metal, another method is pursued when the copper exists in a state of salt, particularly in the state of sulphate and chloride of the metal, as it does in numerous springs, not merely in this country, but in many parts abroad. This method consists of depositing in springs and waters when the cupreous salt is dissolved, small masses of iron: the salt becomes decomposed, its acid attacks the iron, which is dissolved, while the copper is deposited in its place. When first the phenomenon here mentioned was observed, and the reality and importance of its effects ascertained beyond a doubt, the result was for a time characterised, by persons deficient in chemical knowledge, as an actual transmutation of the iron into copper; pieces of the former metal appearing to be decomposed in proportion as the oxyde of the latter was produced. This opinion was the less surprising, when it is considered that, not only were many appearances, now familiarly explained by chemistry, but imperfectly accounted for, but because travellers especially were not always the persons most conversant with such doctrines as might be deemed authentic on these matters. In later times, however, not only have springs impregnated with copper been turned to direct advantage by the smelter, and their principles been illustrated

by analysis; but Dr. Brewster mentions a case, from the *Annales de Chimie*, in which small buttons of pure copper, one of them weighing two ounces and a half, and perfectly malleable, inside a tub used in the preparation of sulphate of copper.

With reference to the alleged transmutation of iron into copper, at which travellers have been so much surprised, and the old chemists so much puzzled, especially by the effect of the waters of Newsol, in Hungary, mentioned by Agricola, bishop Watson remarks that, in the year 1673, our countryman Dr. Brown visited the famous copper mine at Herrn-Grundt, about seven English miles from Newsol; he informs us that he there saw two springs, called the Old and New Ziment, which turned into copper. The workmen showed him a curious cup, made of this transmuted iron; it was gilt with gold, had a rich piece of silver ore fastened in the middle, and the following inscription engraved on the outside:—

Eisen ware ich, kupfer bin ich,
Silber trag ich, gold bedeckt mich.
Copper I am, but iron was of old,
Silver I carry, covered am with gold.

It was even at that time, says Brown, contended by some, that there was no real transmutation of the iron into copper, but that the Ziment water, containing vitriol of copper, and meeting with the iron, deposited its copper; and, it seems, he would have acceded to this opinion, could he have told what became of the iron. "It is," says Dr. Watson, "taken up by the water, and remains suspended in it, in the place of the copper; so that the transmutation is nothing but a change of place; and as the copper is precipitated by the iron, so the iron might be precipitated by potash, or any other substance which has a greater affinity with the acid of vitriol than iron has."

The copper springs in the county of Wicklow, in Ireland, owed the discovery of their valuable quality to the following circumstance. About the middle of the eighteenth century, when the opening of the rich mines of Crone-Bawn had compensated the loss of the more ancient workings of Ballymurtagh, a workman happened to leave an iron shovel in one of the levels from the former mine, by which issued a copious stream strongly impregnated with copper: on taking out the implement some weeks after, it was found so completely incrustated, that it was at first thought to be converted into copper. This accident suggested the advantage of laying bars of iron in the streams, by means of which the copper in the water was precipitated upon the iron, which became corroded by the process, and fell to the bottom as a reddish mud, and which, on being taken out and dried, appeared a sort of dust of the same color, in which state it was ready for smelting. About 500 tons of iron were laid at one time in these pits: in about twelve months, the bars became dissolved; one ton of iron yielding a ton and a half, and sometimes nearly two tons of the metalliferous precipitate; and each ton of the latter producing sixteen hundred weight of pure copper. It is a knowledge of this affinity between the two metals that has furnished the miners with a very simple but almost infallible method of ascertaining whether an ore contains copper; they drop a little nitric acid

the mass; and, after a while, dip a feather into the acid, and draw it over the polished blade of a knife; and if there be the smallest quantity of copper present, it will be precipitated on the steel.

QUERIES.

1. *What are those beautiful colors used in Berlin patterns for rug-work?*—These are all body water colors, and are made by dry opaque pigments tempered with water, in which a little clear size or parchment cuttings have been boiled. The purer colors are the various pigments without admixture with others. Thus the various chromes form the yellows. The arsenite of copper is emerald green. Red lead, vermillion, some of the ochres, &c., are the reds and browns. Smalt is a fine blue; decoctions of various dye drugs and transparent colors, mixed with calcined oyster shells form other colors. Thus carmine water mixed with more or less of the white powder forms the fine pinks. Boiled logwood water, mixed with the same, forms the rose colors. Indigo and Prussian blue, with more or less white, form various blues. The shades of the different colors are occasioned by the admixture of white or black. Greens, purples, fawns, chocolates, and numerous others are formed by the ordinary mixture of the simple colors.

2. *What is the best red color for painting lanthorn sliders?*—The best carmine in powder, mixed as wanted for use, with Canada balsam. Lake is generally considered good enough.

3. *What produces the gloss upon what are called washable or satin paper hangings?*—It is soapstone, or French chalk, ground to a very fine powder. A little of this is put upon the paper, and rubbed on to the surface by means of a hard brush, like a clothes brush. It immediately gives the required gloss. This is also the substance used to rub in the inside of a tight boot, that it may be put on more easily. It is now sold under the name of boot-powder.

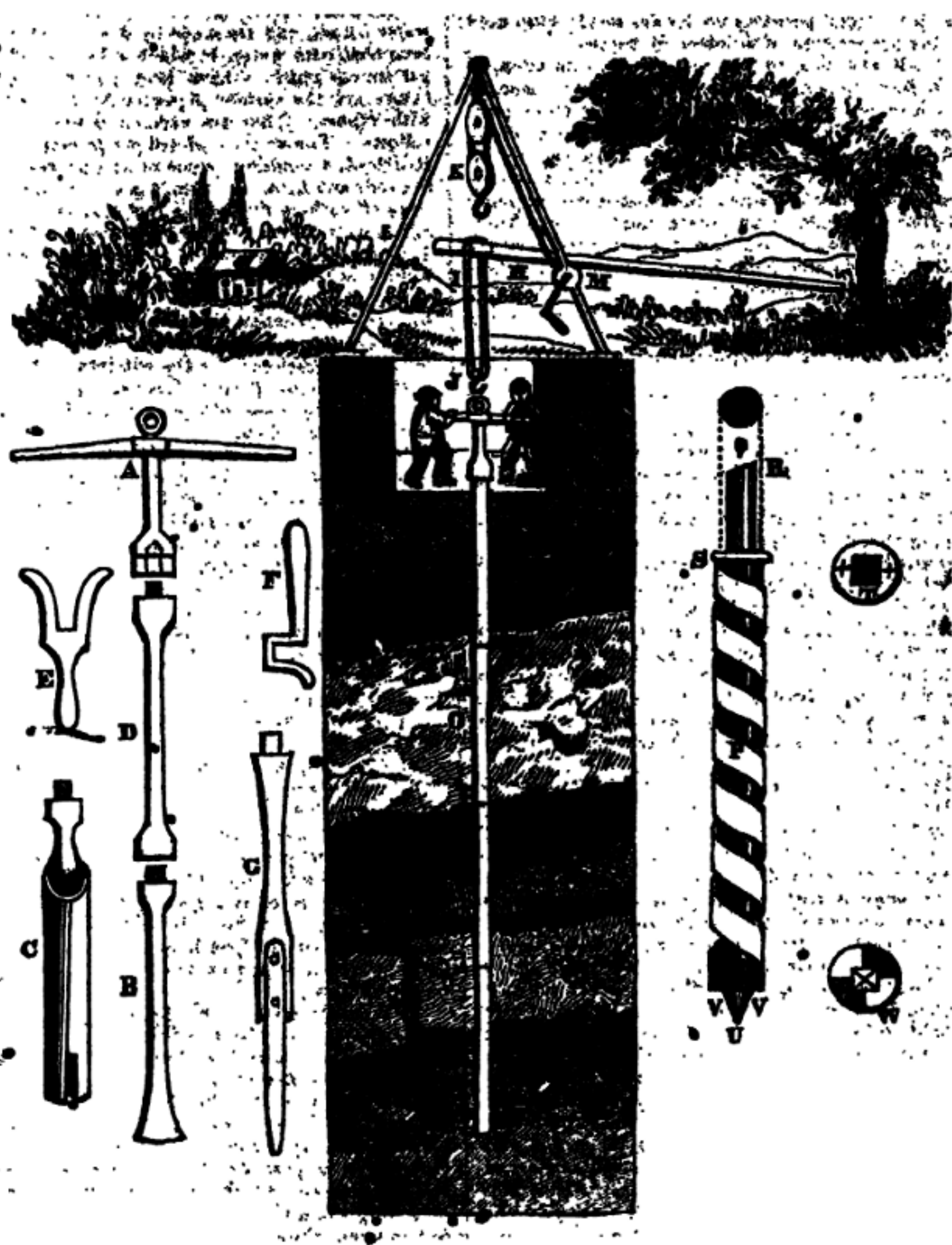
4. *Can you, Mr. Editor, give us any account of how jeweller's rouge is manufactured?*—Take green vitriol, dissolve it in water; then by degrees add carbonate of soda, (used in washing) a powder will fall, which is one kind of rouge. It should be washed in water, and afterwards dried. Another kind is made by putting green vitriol in a crucible, and making it red hot, in which state it may be kept for a quarter of an hour. In the first case a carbonate of iron will be left—in the last case an oxyde of iron.

5. *What colors are used to paint on velvet, particularly how is colored velvet painted upon—for example, how is a yellow flower painted upon blue velvet, a white flower upon a brown ground, &c.*

6. *What is the best work on dyeing?*—We are averse at all times to answer questions of this kind, because, although answered to the best of our ability, yet it is possible that there may be books, and evidently are, which we may not have examined, or having examined, which we may not be able to decide upon, through our own ignorance of the particular subject. Relative to dyeing, however, we believe that Berthollet's work on dyeing is considered the best.

7. *What is the best metal for the wires, knobs, &c. of electrical apparatus?*—Brass is the best, only because it is the cleanest and neatest; in efficacy of conveying the fluid, it is of little consequence what metal is used.

Our Friends and the Public are respectfully informed, that a new Edition, much improved, of this Work, is now in course of Publication, in Monthly Parts, at 1d. and 3d. May be had, by order of all Booksellers.



BORING THE EARTH FOR WATER.

BORING THE EARTH FOR WATER.

AN economical process has been practised of late years for obtaining water from great depths, without the expense of sinking a well. This process consists simply in boring the earth with an auger, and other proper instruments, to a considerable depth; and in most situations water will either flow to the surface, or to within a short distance of it; in some places it has been known to spout to a considerable height above it. It has long been a question whence these springs derive their supply, and how they acquire the power of ascension. The most natural supposition is that they are connected by subterraneous channels with some elevated reservoir, but this explanation is not altogether free from difficulty. These "Artesian Wells," as they are termed, are to be met with in the middle of extensive plains, at a great distance from any hills, and on the sides of mountains which require to be bored a great depth before any water is obtained. At Mount Rouge, at Paris, 80 feet above the level of the Seine, there is one of these wells 315 feet deep. If the force these wells be supplied from an elevated reservoir, it must lie at a very considerable distance from the wells.

The implements made use of in the process are extremely simple, and are represented in the engraving on the preceding page. A is a cross handle of a borer, at which two men are to work. B the chisel borer which is screwed into A. C the auger which also screws into it. D a lengthening rod, having at one end an external screw, which fits into A, and at the other end an internal screw, similar to that of A, and consequently one in which the tools B, C, &c. may be screwed. A great number of these lengthening rods are constantly in readiness, which can be screwed one into the other, so as to descend to the depth of some hundred feet. E is a forked iron used to lay across the hole to support the rods at the joints, while they are being screwed and unscrewed. F a spanner, used to screw and unscrew the various joints. G a clearing chisel, with a probe or piercer attached to guide it. H a spring bar, used to produce a vibrating motion up and down to the chisel, when used to peck away hard or rocky ground. I an iron chain to connect the bar with the cross handle of the borer to the spring bar. J two men at work, boring with the chisel. K the lower pulley of a pair of blocks, suspended to a pair of shears or a triangle above. L the shears or compasses. M winch or crane to work the blocks when great weights are to be raised. O three lengths of rods and the chisel in the act of boring, the depth being about 42 feet. As a preparatory measure, a large hole is usually dug to the depth of 7 or 8 feet, at the bottom of which a floor is laid, by means of some planks, for the men to stand on and pace round while using the instruments. If the earth is very soft, the only tool requisite is the auger C, of 3 or 4 inches in diameter, which is screwed into the cross handle A, and the perforation is easily effected by the mere turning of it round by two men, as shown in the engraving. When the auger has penetrated to nearly the depth of the tube, it is withdrawn and emptied of its contents; it is then let down again, and the perforation is in this manner continued to the whole length of the instrument. To proceed to a greater depth, the lengthening rods, before described, are put in requisition. The auger is detached from the handle by unscrewing it; a piece of rod D is screwed in its place, and the auger screwed on to the rod. With the instrument

thus lengthened 7 or 8 feet, the boring is renewed by means of the auger, as long as the earth is found to be sufficiently soft and yielding. Whenever it proves otherwise, or hard and rocky, the auger is drawn up, detached from the rod and the chisel. B, which is 3 or 4 inches in diameter at the edge, is screwed on in its place. If the ground is not very hard, the boring may be continued by the chisel by the workmen pressing upon it as they turn it round but when the earth is too hard to be operated upon by a chisel in this way, recourse is had to *pecking*, which is done by lifting up the instrument, and sticking it against the opposing surface till it is chipped away, or reduced to powder to a certain depth. The rod and chisel are then again drawn up, and the auger substituted for the chisel for the purpose of extracting the pulverized stony matter contained in the hole. The chisel and auger are thus employed alternately where the ground is hard and strong, the one for chipping away or pulverizing, and the other for clearing out. As the perforation deepens, the process of pecking becomes very laborious, recourse is therefore had to the spring bar H, which is a strong pole placed horizontally over the hole, at the height of 3 or 4 feet from the ground with one end inserted into a post or other strong hold, or else a lever is made of it by a fulcrum near one end, as represented in the cut. The chain I is attached to this bar, and the borer is suspended by the handle to the hook of the chain which supports its weight; a slight vertical motion is then given to the bar by the workmen, which causes the chisel to peck away with great rapidity. As the weight of the implements become too great to be drawn up by hand, when the boring has proceeded to a great depth, the mechanical aid of a pair of pulleys, K is used for the purpose, which are usually suspended from a triangle fixed over the hole. The higher this triangle is the better, so as to enable the workmen to raise a great length of rod, without unscrewing at each joint of the rod. In the manner described, the boring proceeds, changing the tools from time to time for such as may be best suited to cut through the various strata, whether of a soft, indurated, or stony texture, until the main spring is arrived at, when the water flows up the newly-formed tube to the height of the distant spring from which it is derived. If that be at a greater altitude than the surface of the earth bored, the water rises above the ground, producing a perpetual fountain; or the contrary, if it be below the surface, a well must be sunk of some capacity, down lower than the level of the spring; into this well the water flows and forms a reservoir, and may be raised to the surface by means of a pump. The earth is sometimes bored by the before-mentioned simple apparatus to the depth of 2, 3, or 400 feet, either for the purpose of procuring water, or to ascertain the presence of minerals. To carry on the operation at these great depths, a corresponding increase of power is required, which is obtained in a variety of ways. When the hole is bored, a pipe of cast iron or other metal is forced down it to prevent its being filled up again by the falling in of the surrounding earth, and likewise to keep out the impure land springs which might taint the water. Although the process conducted as above described is extremely simple, it is very tedious and laborious, owing to its being necessary to withdraw and unscrew the whole of the rods each time the earth requires to be removed from the boring tool, and to screw them together again upon returning the borer. To obviate these

inconveniences, a method is adopted by which the operation may be carried forwards to great depths, and the earth extracted without withdrawing the rods, by which also, full three-fourths of the time and labor will be saved. The means by which this object is effected are as follows:—An auger is to be made with a spiral worm winding round a cylinder, which forms its centre in the manner of some corkscrews. The cylindrical part is not to be solid, but perforated throughout its whole length by a square hole of two or more inches in diameter, for the purpose of receiving within it an iron bar of the same figure and admeasurement. The bar will thus serve the double purpose of a spindle or shaft to work the auger, or cause it to bore, and of a slide upon which the auger may be drawn up with facility to the surface, from very short depths in a very short space of time, its contents be discharged, and the auger to be let down again as quickly to proceed in the perforation of another portion of earth. That a part of the contents of the spiral auger may not fall out when being drawn up, the worm or thread is not to be left open, but is to have a perpendicular border raised upwards at right angles to the plane of the thread; the aperture between the upper edge of this border and the next thread is left open for clearing out the auger with facility. The construction will be easily understood, by referring to the engraving, in which P represents the exterior of the spiral worm or auger. Q the square iron bar passing through the square tube of the auger. R chains to draw up the spiral worm along the bar. S top plate to which the chains are attached. T upper view of the plate, showing the square hole through which the bar passes. U angular point of the square bar. V V cutting edges of the auger. W underside view of the bottom cutting parts of the auger.

IRON FOUNDING.

OWING to the immense demand for cast iron in most of our great public works, such as bridges, rail-roads, columns, girders, fences, gas and water pipes, house-building, framing of machinery, and innumerable objects of less magnitude, iron founding has become one of the most interesting and important of our national manufactures. Wherever a foundry is to be formed, a dry situation should be selected for it, as dampness would totally prevent anything being cast with tolerable accuracy, besides rendering the founding, in such places, dangerous to the workmen employed. The floor of a building for this business should be about 10 feet deep, and composed of a kind of loamy sand; and if the place selected does not afford this convenience naturally, the ground must be made hollow, and such sand brought to fill up the excavation. This loamy sand is for the purpose of burying large moulds beneath its surface, so that the metal may be conveyed to them by channels or soughs hollowed out of the sand, and through which it runs from the furnace to the mould to be cast. A foundry, or casting-house, is provided with as many air or reverberating furnaces, in addition to the blast furnaces, as is required for the extent of the works to be founded at it; an air or reverberating furnace is only used occasionally, either when the metal contained in the blast furnace is not sufficient, or when the quality made in it is not proper for the work about to be cast. The difference in the qualities of the metals arises from their containing too much or too little

carbon, and this is corrected by the founder, who mixes them with better or worse metal till they are rendered fit for the purpose required. Cupolas, as they are called, are also wanted in a foundry, and are similar to the blast furnace, except being of somewhat smaller capacity; they are used to melt small quantities of metal when it is wanted in haste, as the reverberatory or blast furnaces will take more time in filling the charge of metal than the cupola does, by reason of their being of larger capacity; but the founding by cupolas requires more machinery, from which circumstance it is not so well adapted to answer the purpose of the founder as the employment of a reverberatory or blast furnace. A much greater stock of flasks and other implements is wanted to make the moulds with, than is required by the caster who performs his work by means of either of the other furnaces; these kinds of furnaces are always in use at large foundries, as at such places can be employed the whole charge of metal they are capable of containing. In a foundry worked by a blast furnace, a pit is sunk at a convenient distance from it, and the moulds for all large articles, such as pipes, &c. are placed vertically in it, within reach of the crane, that they may be raised or lowered in the pit. The metal is conveyed from the furnace by a gutter or trough made in the floor of the foundry, and a small iron trough, filled with sand, conducts the fluid metal into the moulds. This method of performing foundings at large works is an improvement on the old one, (which consisted in burying the pattern in sand,) and which has caused a great saving in labor and time. The flasks for this method of casting are founded of iron. It is now a practice at most of our large foundries to substitute sand for loam castings, in cases in which there are a great number of articles of the same kind to be cast, so that the expense of the flasks becomes an object of no great importance. When it happens that the articles are intricate, the sand is wetted so much as to render it sufficiently adhesive to make it mould, and receive the form of the pattern completely; after this is done, it is necessary to dry the mould, to prevent accidents by the explosion of the hot metal when running the cast; for this purpose stoves are used in which an equal and moderate degree of temperature is produced, and of a capacity adequate to contain a good number of the patterns. The moulds, when ready to be dried, are placed upon a carriage adapted to the purpose, and on which they are arranged and conveyed to the oven; and when dry, which generally happens in about half an hour, they are withdrawn, and a new set placed upon the carriage. Every foundry should be provided with one or more cranes, so placed as to be easily got at when it is required to raise, lower, or remove, any large piece of casting. The moulding of large pieces of cast-iron, when they are required to be hollow, is made in loam, and consists in laying down an iron ring upon the ground, of the diameter of the proposed calibre of the work to be cast, and which has a rod of iron in its centre; after this is done, bricks, clay, and wet loam are mixed together, and built up within the ring and round the iron rod, of somewhat less diameter than the cylinder about to be cast, and for which this is to form the core. The whole, when built, is bound round with iron hoops to protect it, and a fire is made inside to dry it; and when properly dried, a coating of loam is spread all over and smoothed; this coat fills up and makes it the proper size for the inside of the cylinder, and is called the core of the mould. Another cylinder

is built and plastered in the same manner, but without hoops, whose diameter is the same as the outside of the cylinder to be founded. When this is finished, it is covered over with charcoal dust, or ground charcoal, which is mixed up with water like paint, and laid on with a brush; and a thin coating of loam, mixed up with hair, is then laid over the charcoal, previously spread upon the inner cylinder. When all these are quite dry, a man gets into the cylinder, and with a picker pulls away from the core the bricks, and then with a trowel cuts away also the loam, leaving the inside of the external cylinder, which is called the mould, quite smooth; this part of the work is effected by the coat of charcoal, which prevents the two coats of loam from adhering together. While this is doing, a deep pit is dug, and into this the core is let down by a crane; when this is done, the mould is lowered over the core; as soon as the adjustment is perfected, sand is thrown in and rammed round about it, to about the half of its height; after which a flat cover of dried loam is put on the top of the mould and core, and pieces of rounded wood are put into the holes, which had been before made for pouring in the metal. The plugs which keep open these holes are carefully taken out, and small channels prepared for the metal to run through from the furnace. Before the metal is run into the mould, the latter should be carefully examined, to ascertain that it is quite dry, and in other respects in a perfect condition to receive the metal. Sand, or open casting, is used for such articles as will allow of cutting into two pieces, or even more, the models of which are indented in the sand, and the metal is run in between flasks.

The founding of iron cannon is conducted in a similar manner to other castings; the pattern is moulded in the sand, and the metal run into the mould through a gutter. Small guns are moulded on tables, one half of the mould being formed on one table, and its counterpart on another; they are fitted together by pins, and screwed up by nuts and bolts to keep them firm together whilst the hot metal is run in. About fifty years ago cannons were cast with a hollow cavity for the bore, which was afterwards enlarged and cleaned out by a machine adapted to the purpose. Guns are now invariably cast solid, owing to the difficulty of getting them perfectly sound by that mode of casting, being more or less spongy in some parts, which the subsequent turning did not wholly remove.

BACK-PAINTING ON GLASS.

THIS manner of painting is executed with great facility; it gives all the softness that can be desired, and is easy to work; there are no outlines to draw, nor shadows to insert, but your colors are put on without the trouble of either. The prints for this purpose are done in mezzotint, but many of those well-finished, engraved in the manner of chalks, are very proper; for their shadows blended together, when rubbed on the glass, appear soft and united as drawings on Indian ink; such prints to have their margin cut off; then on a piece of fine crown glass very clean, the size of the print, and free from knots and scratches, lay some Venice turpentine on one side, quite thin and smooth with a painter's brush—lay the print flat in water; when thoroughly wetted, which requires twenty-four hours for some sorts of paper, but other sorts are ready in two hours, take it carefully out, and lay it between dry papers that the superfluous water may be absorbed;

next, lay the damp print flat on a table, with its face uppermost, then holding the glass over it, without suffering the turpentine to touch it till it is exactly even with the print, gently press the glass in several parts, and turning it, press the print with your fingers, drawing it from the centre to the edges, till it is quite smooth and free from blisters; when this is done, wet the back of your print with a sponge till the paper will come off with your fingers; then rub it gently and the white paper will roll off, only the ink which formed the impression, remaining. When dry, with a camel-hair pencil, dipped in oil of turpentine, wet it all over, and it will be perfectly transparent, and fit for painting on; a sheet of white paper, placed behind, will contribute to its transparency. Lay the lighter colors first on the light parts of your prints, and the darker over the shaded; and having once laid on the brighter colors, it is not material if the darker sorts are laid a little over them, for the first color will hide those laid on afterwards.

The glass, when painted, must stand three or four days to dry, and be carefully covered from dust. The proper colors are those used in oil.

MEDICAL ELECTRICITY.

(Resumed from page 261.)

HAVING already described the apparatus proper for administering medical electricity, we shall at once proceed to show in what disorders and how applied we have found it beneficial, throwing out of all consideration the cures effected, or said to be effected by the quacks who first practised this science medically.

The first case which we undertook was most important and most successful. It was a case of gutta serena, or derangement of the optic nerve. The patient was a lady of 18 or 20 years of age, of general ill health and nervous temperament. When she first attended to be electrified, she was so blind as not to be able to see the sun at noon day, and it was stated that this deprivation of sight had been gradually coming upon her for months. She was placed upon the insulating chair, and the fluid drawn from her eyes by a wooden point held at from 1 to 2 inches from them, this was continued for about a quarter of an hour, or until the eyes watered, and felt warm to herself. Not to irritate them too much, the process was then discontinued, and resumed the following day, and so on each day for six weeks. At first it seemed to produce but little effect; in a fortnight however, the lady could see the sun and the moon, and knew on which side of a room the windows were; in a fortnight more, she could well distinguish the ordinary furniture of a room, or walk unassisted along the serpentine walks of the pleasure grounds. Her sight gradually improved, though very slowly, until she could recognize objects, and even snuff a candle, though there always continued till her death, which took place two years afterwards, a strong mistiness before her eyes, as if every thing around was invested with a dense steam.

We tried the same agent in other similar cases, sometimes with, at others without success. It seems to restore tone to those parts which have lost it, but does not appear to have any further effect in diminishing disease.

The next form in which it is administered, that of sparks, attended or not with vibrations and shocks, is applicable to other disorders, and being a more energetic method, is more useful. In cases of rigidity

and laxity of the muscles, and in paralysis, we have found it often of great value. Those afflicted with gout and rheumatism, have often their knees bent, their back crooked, their hands folded inwards. Taking sparks from the parts most affected daily for a quarter of an hour at a time, we have found almost invariably to do good, particularly for the first week, after which, generally speaking, the effect is not so perceptible; we have known some persons entirely cured, who had been years afflicted. One remarkable case of this kind occurred at Chigwell, where we then resided and practised. It was of a painter named Turpin, who had been bedridden for two years with painter's palsy, he could scarcely move hand or foot, he had tried tonic and other medicines in vain. He was electrified by sparks, resting at the time in a recumbent posture on a long stool, made for the purpose, and which was supported upon six glass bottles. The electrization was continued daily for some weeks, with a very slow but decided improvement. The constant attendance requisite, rendered it expensive to him, yet hopes of his amendment induced him to continue the electrifying. He purchased a machine, and was operated upon in the same manner for two years, until completely restored to health, and able to pursue his previous avocations.

We could adduce numberless instances of benefit in chronic rheumatism, in chilblains, in contractions, in tic doloureux, and other disorders, even in schirous affections, we have found it beneficial. Why it should be so, is perhaps because it promotes a quicker circulation of the blood, through the smaller vessels. We will introduce an experiment or two to show the probability that such is the case.

Ex.—Construct a small bucket of metal or wood, let it have a hole in the bottom, through which water may flow. (Should we be at a loss for a bucket, make one of a turnip or potato cut hollow, and having a piece of tobacco pipe thrust through the bottom of it.) Suspend this by a wire or chain from the conductor of a machine, put a little water in it, and observe that the water falls in distinct drops. Now turn the machine, and the water will be divided in numerous streams. The various particles being repelled from each other by the fluid



entering into them. Something similar appears to take place in the action of the fluid upon blood, except that we must bear in mind that in the body the blood is inclosed, in the bucket it is let fall. The validity of the reason however we will not contend for, but will adduce a remarkable fact in confirmation of the value of electricity in its action upon liquefying the blood. A gentleman in Jan. of 1815, was thrown from his horse, was insensible, there appeared no external injury, restoratives were tried without effect, a vein was opened in the arm, no blood flowed; the temporal artery was tried, till no blood. We were when he was brought in

electrifying a patient; to try the effect of a shock was suggested, but the Leyden jar was not ready, while preparing, we placed him on the stool, turned the machine, and instantaneously the blood flowed from both incisions, first by drops, then in a full stream, and the man was soon restored to consciousness.

As we do not profess to make this magazine a medical work, we will not further dwell upon this subject, yet before we leave it, will describe a pretty little apparatus which acts upon exactly the principle of that of the medical electrometer, which we described in the last paper upon this subject. This account we the more readily admit, having been asked for a description upon two or three occasions of the *Electrical Sportsman*, the representation of which is beneath. It is to illustrate the fact, that a charged electrical jar will discharge itself if the outer and inner coating approach too closely. The



inner coating of the Leyden jar is connected with two wires, one of which proceeds to the birds, (these are small pieces of pith, with feathers for wings,) and attached to 4 or 5 inches in length of a fine linen thread. The other wire proceeds to within a small distance of the muzzle of the gun. The gun is connected with the outer coating of the phial by means of the wire proceeding from it to the figure, and a slip of tin foil, which is pasted along the figure to the muzzle. Connecting the phial with the electrical machine in action, it will of course become charged, during which time the birds will elevate themselves by electrical repulsion; when the bottle is charged to a certain extent, the distance between the muzzle of the gun and the ball near it will not be sufficient to restrain the passage of the fluid, which will therefore pass between them, occasioning at the same time a flash of light, a loud report, and the falling of the birds.

THERMOGRAPHY.

BY ROBERT HUNT

(Secretary to the Royal Cornwall Polytechnic Society.)

[To the subject of the following paper we solicit the attention of our readers, as it bids fair to be of considerable importance to art, as well as to explain numerous phenomena of light and heat, hitherto involved in obscurity and doubt. We have been favored with it by the author himself, to whom for his valuable communication we return our thanks, and are sure that he will allow us to quote from the letter with which it was accompanied his concluding remark. "Every day brings me acquainted with new phenomena of the most extraordinary kind in connexion with this matter." We may also relate the following fact, often observed, but never heeded. Copper-plates as they are supplied by the maker, are sometimes wrapped in tissue paper, and then in ordinary waste paper, and very frequently

waste printed paper. The plate after a time will bear upon its bright surface a very clear impression of the printed matter, although the tissue paper is interposed between them, the tissue paper remaining unstained; we have seen this repeatedly.—En.]

The Journal of the Academy of Sciences at Paris, for the 18th of July, 1842, contains a communication, made by M. Regnault from M. Moser, of Königsberg, "*Sur la formation des images Daguerriennes*;" in which he announces the fact, that *when two bodies are sufficiently near, they impress their images upon each other.* The Journal of the 29th of August contains a second communication from M. Moser, in which the results of his researches are summed up in twenty-six paragraphs. From these I select the following, which alone are to be considered on the present occasion.

"9. All bodies radiate light even in complete darkness.

"10. This light does not appear to be allied to phosphorescence, for there is no difference perceived whether the bodies have been long in the dark, or whether they have been just exposed to day-light, or even to direct solar light.

"11. Two bodies constantly impress their images on each other, even in complete darkness.

"14. However, for the image to be appreciable it is necessary, because of the divergence of the rays, that the distance of the bodies should not be very considerable.

"15. To render the image visible, the vapour of water, mercury, iodine, &c. may be used.

"16. There exists *latent light* as well as latent heat."

The announcement at the last meeting of the British Association of these discoveries, naturally excited a more than ordinary degree of interest. A discovery of this kind, changing, as it does, the features, not only of the theories of light adopted by philosophers, but also the commonly-received opinions of mankind, was more calculated to awaken attention than any thing which has been brought before the public since the publication of Daguerre's beautiful photographic process. Having instituted a series of experiments, the results of which appear to prove that these phenomena are not produced by *latent light*, I am desirous of recording them.

I would not be understood as denying the absorption of light by bodies, of this I think we have abundant proof, and it is a matter well deserving attention. If we pluck a nasturtium when the sun is shining brightly on the flower, and carry it into a dark room, we shall still be enabled to see it by the light which it emits.

The human hand will sometimes exhibit the same phenomenon, and many other instances might be adduced in proof of the absorption of light; and I believe, indeed of the principle that light is latent in bodies. I have only to show that the conclusions of M. Moser have been formed somewhat hastily, being led, no doubt, by the striking similarity which exists between the effects produced on the Daguerre-type plates under the influence of light, and by the juxtaposition of bodies in the dark, to consider them as the work of the same element.

1. Dr. Draper in the "*Philosophical Magazine*" September, 1840, mentions a fact which has been long known, "That if a piece of very cold clear glass, or what is better, a cold polished metallic reflector, has a little object, such as a piece of metal laid on it, and the surface be breathed over once, the object being then carefully removed, as often as you

breathe again on the surface, a spectral image of it may be seen, and this singular phenomenon may be exhibited for many days after the first trial is made." Several other similar experiments are mentioned, all of them going to show that some mysterious molecular change has taken place on the metallic surface, which occasions it to condense vapours unequally.

2. On repeating this simple experiment, I find that it is necessary, for the production of a good effect, to use dissimilar metals; for instance, a piece of gold or platina on a plate of copper, or of silver will make a very decided image, whereas copper or silver on their respective plates gives but a very faint one, and bodies which are bad conductors of heat, placed on good conductors, make decidedly the strongest impression when thus treated.

3. I placed upon a well-polished copper plate, a sovereign, a shilling, a large silver medal, and a penny. The plate was gently warmed by passing a spirit lamp along its under surface; when cold, the plate was exposed to the vapour of mercury; each piece had made its impression, but those made by the gold and the large medal were most distinct, not only was the disc marked, but the lettering on each was copied.

4. A bronze medal was supported upon slips of wood, placed on the copper, one-eighth of an inch above the plate. After mercurialization, the space the metal covered was well marked, and for a considerable distance around the mercury was unequally deposited, giving a shaded border to the image; the spaces touched by the mercury were thickly covered with the vapour.

5. The above coins and medals were all placed on the plate, and it was made too hot to be handled, and allowed to cool without their being removed; impressions were made on the plate in the following order of intensity.—gold, silver, bronze, copper. The mass of the metal was found to influence materially the result; a large piece of copper making a better image than a small piece of silver. When this plate was exposed to vapour, the results were as before, (3, 4.) On rubbing off the vapour, it was found that the gold and silver had made permanent impressions on the copper.

6. The above being repeated with a still greater heat, the image of the copper coin was, as well as the others, most faithfully given, but the gold and silver only made permanent impressions.

7. A silvered copper plate was now tried with a moderate warmth, (3.) Mercurial vapour brought out good images of the gold and copper; the silver marked, but not well defined.

8. Having repeated the above experiments many times with the same results, I was desirous of ascertaining if electricity had any similar effect; powerful discharges were passed through and over the plate and discs, and it was subjected to a long-continued current without any effect. The silver had been cleaned off from the plate, (7;) it was now warmed with the coins and medals upon it, and submitted to discharges from a very large Leyden jar, on exposing it to mercurial vapour, the impressions were very prettily brought out; and strange to say, spectral images of those which had been received on the plate when it was silvered (7). Thus proving that the influence, whatever it may be, was exerted to some depth in the metal.

9. I placed upon a plate of copper, blue, red, and orange colored glasses, pieces of crown and flint glass, mica, and a square of tracing paper. These were allowed to remain in contact half an

hour. The space occupied by the red glass was well marked, that covered by the orange was less distinct, but the blue glass left no impression; the shapes of the flint and crown glass were well made out, and a remarkably strong impression where the crown glass rested on the tracing paper, but the mica had not made any impression.

10. The last experiment repeated, after the exposure to mercurial vapor, heat was again applied to dissipate it, the impression still remained.

11. The experiment repeated, but the vapor of iodine used instead of that of mercury. The impressions of the glasses appeared in the same order as before, but also a very beautiful image of the mica was developed, and the paper well marked out, showing some relation to exist between the substances used, and the vapors applied.

12. Placed the glasses used above (9, &c.), with a piece of well smoked glass for half an hour, one-twelfth of an inch below a polished plate of copper. The vapor of mercury brought out the image of the smoked glass only.

13. All these glasses were placed on the copper, and slightly warmed, red and smoked glasses gave after vaporization, equally distinct images, the orange the next, the others left but faint marks of their forms; polishing with Tripoli and putty powder would not remove the images of the smoked and red glasses.

14. An etching, made upon a smoked etching ground on glass, the copper and glass being placed in contact. The image of the glass only could be brought out.

15. A design cut out in paper, was pressed close to a copper plate by a piece of glass, and then exposed to a gentle heat; the impression was brought out by the vapor of mercury in beautiful distinctness. On endeavouring to rub off the vapor, it was found, that all those parts which the paper covered, amalgamated with mercury, which was removed from the rest of the plates; hence there resulted a perfectly permanent white picture on a polished copper plate.

16. The colored glasses before named (9, 12), were placed on a plate of copper with a thick piece of charcoal, a copper coin, the mica and the paper, and exposed to fervent sunshine. Mercurial vapor brought up the images in the following order, smoked glass, crown glass, red glass, mica beautifully delineated, orange glass, paper, charcoal, the coin, blue glass; thus distinctly proving that the only rays which had any influence on the metal, were the calorific rays. This experiment was repeated on different metals, and with various materials, the plate being exposed to steam, mercury, and iodine; I invariably found that those bodies which absorbed or permitted the permeation of the most heat gave the best images. The blue and violet rays could not be detected to leave any evidence of action, and as spectra imprinted on photographic papers by light, which had permeated these glasses, gave evidence of the large quantity of the invisible rays which passed them freely, we may also consider those as entirely without the power of effecting any change on compact simple bodies.

17. In a paper which I published in the "Philosophical Magazine," for October, 1840, I mentioned some instances in which I had copied printed pages and engravings on iodized paper, by mere contact and exposure to the influence of the calorific rays, or to artificial heat. I then, speculating on the probability of our being enabled by some such pro-

cess as the one I then named, to copy pictures and the like, proposed the name of THERMOGRAPHY, to distinguish it from photography.

18. I now tried the effects of a print in close contact with a well polished copper plate. When exposed to mercury, I found that the outline was very faithfully copied on the metal.

19. A paper ornament was pressed between two plates of glass, and warmed; the impression was brought out with tolerable distinctness on the under and warmest glass, but scarcely traceable on the other.

20. Rose leaves were faithfully copied on a piece of tin plate, exposed to the full influence of sunshine, but a much better impression was obtained by a prolonged exposure in the dark.

21. With a view of ascertaining the distance at which bodies might be copied, I placed upon a plate of polished copper, a thick piece of plate glass, over this a square of metal, and several other things, each being larger than the body beneath. These were all covered by a deal box, which was more than half an inch distant from the plate. Things were left in this position for a night. On exposing to the vapor of mercury it was found that each article was copied, the bottom of the deal box more faithfully than any of the others, the grain of the wood being imaged on the plate.

22. Having found by a series of experiments, that a blackened paper made a stronger image than a white one, I very anxiously tried to effect the copying of a printed page or a print. I was partially successful on several metals, but it was not until I used copper plates amalgamated on one surface, and the mercury brought to a very high polish, that I produced any thing of good promise. By carefully preparing the amalgamated surface of the copper I was at length enabled to copy from paper, line-engravings, wood cuts, and lithographs, with surprising accuracy. The first specimens produced exhibit a minuteness of detail and sharpness of outline, quite equal to the early Daguerreotypes and the photographic copies, prepared with chloride of silver.

The following is the process at present adopted by me, which I consider far from perfect, but which affords us very delicate images.

A well polished plate of copper is rubbed over with the nitrate of mercury, and then well washed to remove any nitrate of copper which may be formed; when quite dry a little mercury taken up on soft leather or linen is well rubbed over it, and the surface worked to a perfect mirror.

The sheet to be copied is placed smoothly over the mercurial surface, and a sheet or two of soft, clean paper being placed upon it, is pressed into equal contact with the metal by a piece of glass, or flat board; in this state it is allowed to remain for an hour or two. The time may be considerably shortened by applying a very gentle heat for a few minutes to the under surface of the plate. The heat must on no account be so great as to volatilize the mercury. The next process is to place the plate of metal in a closed box, prepared for generating the vapor of mercury. The vapor is to be slowly evolved, and in a few seconds the picture will begin to appear; the vapor of mercury attacks those parts which correspond to the white parts of the printed page or engraving, and gives a very faithful, but a somewhat indistinct image. The plate is now removed from the mercurial box, and placed into one containing iodine, to the vapor of which it is

exposed for a short time; it will soon be very evident that the iodine vapor attacks those parts which are free from mercurial vapor, blackening them. Hence there results a perfectly black picture, contrasted with the grey ground formed by the mercurial vapor. The picture being formed by the vapors of mercury and iodine, is of course in the same state as a Daguerreotype picture, and is readily destroyed by rubbing. From the depth to which I find the impression made into the metal, I confidently hope to be enabled to give to these singular and beautiful productions, a considerable degree of permanence, so that they may be used by engravers for working on.

It is a curious fact the vapors of mercury and of iodine attack the plate differently, and I believe it will be found that vapors have some distinct relation to the chemical, or thermo-electrical state of the bodies upon which they are received. Moser has observed this, and attributes the phenomena to the colors of the rays, which he supposes to become latent in the vapor on its passing from the solid into the more subtle form. I do not however think this explanation will agree with the results of experiments. I feel convinced that we have to deal with some thermic influence, and that it will eventually be found that some purely calorific excitement produces a molecular change, or that a thermic-electric action is induced, which effects some change in the polarities of the ultimate atoms of the solid.

These are matters which can only be decided by a series of well conducted experiments, and, although the subject will not be laid aside by me, I hope the few curious and certainly important facts which I have brought before you, will elicit the attention of those whose leisure, and well known experimental talents, qualify them in the highest degree, for the interesting research into the action of those secret agents, which exert so powerful an influence over the laws of the material creation. Although attention was called to the singular manner in which vapors disposed themselves on plates of glass and copper, two years since by Dr. Draper, Professor of Chemistry at New York, and about the same time to the calorific powers of the solar spectrum, by Sir John Herschel, and to the influence of heat artificially applied, by myself (17;) yet it is certainly due to M. Moser, of Königsberg, to acknowledge him to be the first who has forcibly called the attention of the scientific world, to an inquiry which promises to be as important in its results, as the discovery of the electric pile by Volta.

As to the practical utility of this discovery, when we reflect on the astonishing progress made in the art of photography since Mr. Fox Talbot published his first process, what may we not expect from Thermography, the first rude specimens of which exhibit far greater perfection than the early efforts of the sister art. As a subject of pure scientific interest, Thermography promises to develop some of those secret influences which operate in the mysterious arrangements of the atomic constituents of matter, to show us the road into the yet hidden recesses of nature's works, and enable us to pierce the mists which at present envelope some of the most striking phenomena, which the penetration and industry of a few "chosen minds" have brought before our obscured visions. It has placed us at the entrance of a great river, flowing into a mighty sea, which mirrors in its glowing waters some of the most brilliant stars which beam through the atmosphere of truth.

BREAD WITHOUT YEAST.

(To the Editor.)

SIR.—Having tried the following recipe for making bread without yeast, and found it to answer extremely well, I take the liberty of sending it to you, to put into the "Magazine of Science," should you think proper to do so.

W. S.

Esfield, Nov. 18, 1842.

Take of carbonate of soda 2 ounces, tartaric acid 1 ounce and a half, common salt 2 ounces, mix well together. With the above, 12 pounds of flour are to be intimately mixed, and kneaded and baked in the usual manner. If the ingredients are kneaded with sweet milk instead of water, the bread will be much richer. The bread so produced is well adapted for people of a constipated habit, as it has a moderate aperient quality.

ANSWERS TO QUERIES:

8. *How is the paper prepared for the metallic pencil memorandum books?*—*First Answer.* By applying to the surface of good paper a solution of isinglass, with a small quantity of white lead powder mixed in it.

JOHN FAWCETT.

Gateshead, Nov. 2, 1842.

Second Answer. By rubbing the paper slightly over with phosphate of lime, i.e., bones burnt to whiteness, and mixing it, after being well pounded, with size. Prepared hartshorn will answer the same purpose as the bones prepared.

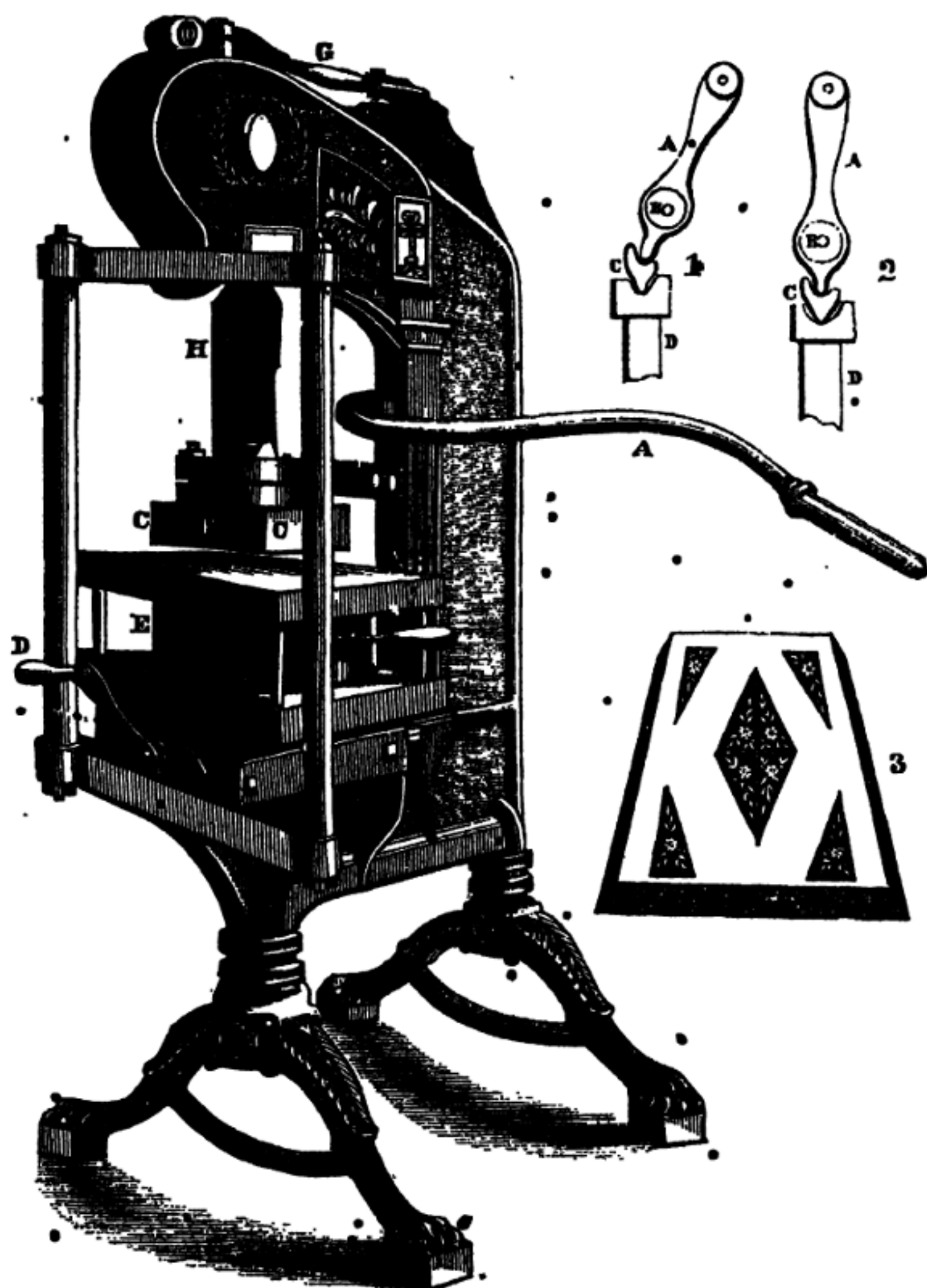
J. A. DICKETT.

MEMORANDA.

Quantity of Heat disengaged during Combustion.—It has been found by M. Despretz, that hydrogen gas in burning melts 315.2 times its weight of ice; and carbon 104.2. M. Wetter remarks, that these numbers 315.2 and 104.2, are almost precisely proportional to the weight of oxygen absorbed by the hydrogen and the carbon; and it appears by the chemical proportions of Berzelius, that the first number being 315.2, the second will be 104.66. This discovery is in accordance with M. Wetter's conjecture, that the quantities of heat disengaged are in definite proportions.

Capillary Attraction.—It is stated by Mr. Gilleron, that if a capillary tube be introduced into mercury, the metal will remain in the tube below the exterior surface. If then the tube be carefully raised, without taking it out of the mercury, the surface of the mercury in the tube may be raised to the level of that without. Operating very carefully it may even be raised still higher; its surface will then become concave, the nature of the curve apparently approaching that of the catenarian curve, which I believe to be also that of liquids, which in capillary tubes are raised above the level of the external surface. If then the tube be depressed a little, the convex surface may again be given to the mercury in the tube, without its level being depressed below that of the external portion. It appears to me, therefore, that the surface of liquid in capillary tubes is an accessory circumstance, and has no direct influence on the elevation or depression of the liquid.—*Biblio. Univer.*

Our Friends and the Public are respectfully informed, that a new Edition, much improved, of this Work, is now in course of Publication, in Monthly Parts, at 7d. and 8d. May be had, by order, of all Booksellers.



SHERWIN AND COPE'S ARMING PRESS.

• THE ARMING PRESS.

We have all of us daily opportunities of witnessing the beautiful patterns stamped upon the covers of those books which are bound in cloth, and no doubt have often made a comparison in our own minds between the present cheap style of binding books, and that which was in use a few years ago, when scarcely anything but a dull colored paper formed the cover of the generality of works which issued from the press. In as far as appearance is concerned the present style of bookbinding is admirable; indeed to dwell upon such a truism would be but a waste of time and space, especially as we gave a very full account of the whole process in Vol. II. In that article, page 206, we alluded pointedly to the press of Messrs. Sherwin, Cope, & Co., which was used to stamp the covers of cloth bound and other books; having been repeatedly asked for a figure and fuller description of this press, we have procured for and given one in the present number. So simple and easy to work is this press that we can say little more on its capacity and mode of working than that we have already inserted, yet the principle of the leverage by which the pressure is occasioned; the formation and fixing in of the embossed pallet, and the ingenious method adopted for raising the bed of the press to suit the thickness of the cover is deserving of attention.

In general appearance the press is similar to the Imperial printing press of the same parties. A is a handle, by pulling which the heater box CC is pulled down to the table or bed of the press, consequently anything placed upon the bed beneath will receive the pressure. CC is a perfectly flat surface, except a groove cut in it, as is seen at F; if therefore C is brought down to the bed it would exactly coincide with it everywhere except at the groove. This being remembered, let us take an unyielding piece of brass, formed of an exact thickness all over, as to its prominent parts; let one side of it be cut of any required device, as in Fig. 3, and the size of the whole so exactly as to slide with the device downwards into the groove at F; then it is evident that the device, whatever it may be, would be impressed upon any yielding matter which should be put beneath it, when the press is pulled down, and this impression would be equal at all parts, because the bed and heater box have been formed true to each other; the brass tool also is of equal thickness and all of them unyielding to ordinary pressure.

The next thing requisite is to consider the thickness of the book cover, and to regulate the pressure accordingly. It may be thought that as the pressure is occasioned by pulling the handle forwards, the workman could judge of the requisite pressure by the resistance he meets with; this is very well in theory but not in practice, all presses of this nature and also all printing presses, must have a means of adjustment, so that but little shall be left to chance. The adjustment in this press is beneath the bed, and a most ingenious one it is. At E is seen a large cylinder of iron, cut in four teeth; one half of this, that is the lower half, has a straight handle attached to it, and the only thing required to raise or depress the bed is to move this handle forwards or backwards, for the two sections of the cylinder F slide upon each other smoothly, yet so firmly that they are not liable to be misplaced, to jar, or to deviate from the position they are placed in. Now as there is but a very small space between the heater box and the bed when the whole is ready to work, it is

requisite that the bed should draw out and in to a certain extent, to regulate the first adjustment of each sized book. This is accomplished by means of the handle D, the turning of which moves the bed.

The next thing that deserves attention is the use of two holes, one on each side of F in the heater box. These two holes contain each a gas light arising from a gas pipe conveyed by any convenient method from behind. The object of this is to heat the brass tool in order to take advantage of the well-known influence of heat in occasioning certain substances to yield more easily to pressure, as we witness daily in hotpressing, in domestic ironing, &c. Were the brass tool not heated, the impression would be very faint, and would neither have the smoothness nor glossiness, which is necessary to beauty. The gas lights heat the heater box, and the heater box heats the tool. It may be thought that this is a very imperfect method of heating, and that there must necessarily be a great waste of fuel or gas, especially as heat ascends rather than descends. This objection is in some degree correct, the more especially as the holes soon become loaded with soot, and much heat escapes out of the front of the holes. Notwithstanding this there is no way of overcoming the evil complained of without occasioning a greater. Were the gas flames beneath, and therefore the tool on the bed of the press, the workman must attach his book to the heater box, where a nice adjustment would be difficult and he would be annoyed and his work injured by the heat and soot being below, whereas now he and his work are free from both. The expenditure of gas is moreover very little.

The action of the handle in lowering the platten is extremely ingenious and very powerful. The internal structure is seen in Figs. 1 and 2. Figure 1 being the position of the internal parts before the pull is made, and Fig. 2 the position which they assume during the act of pulling. This work is contained in the space between H and the top of the press, immediately over it. The handle itself is connected with an upright rod, which draws back the level G, this acts by another short lever upon the top of the levers AA, as shown in the cuts Nos. 1 and 2. B is called the *chill*; the main bolt, as seen in the large cut surrounded by a wreath of leaves, passes through this hole. C is the *cup*, and D is the *piston bolt*. When the handle is pulled, it drives down the cup C owing to the different position which the lever A takes, and of course the bolt D descends, and with it the platten. There is a spring, or in the improved presses, two springs, beneath the head of the press, which bring the heater box up again when the handle is released.

The process of stamping a book is very easy; marks with chalk or otherwise are made upon the bed, or else two thin pieces of brass at right angles are screwed upon it, where the book is to go. The covers are already on the book, one cover is then bent back, placed on the edge of the bed, the book itself hanging down, the bed run into its place by the handle D. The handle A is pulled, the book taken out, the other cover put in in like manner, a second pull made, and the book taken out completely embossed on both sides.

Presses of this description sell from £12 12s. to £75.

The above parties also manufacture arming presses with double cast checks at the same prices.

RED SNOW PLANT.

We promised in page 274 to give a different origin from that which is there assigned for the cause of the red snow; the following account is the fullest and most interesting which has been written upon the subject:—

The red snow plant, when viewed under the highest powers of a simple microscope, appears to consist of globules containing a red fluid. We select the following observations upon its history, from a communication made to the "News of Literature and Science," on the 21st of January, 1826.

"Our scientific readers will remember the interest which was excited on the subject of this natural production, upon the return of Captain Ross from his Polar expedition, some years since. At that time it was examined by three of the most acute observers in this country, especially of microscopical objects, Wollaston, Brown, and Bauer, who all formed a similar conclusion in one respect, that it was of vegetable origin, but were of different opinions as to its precise nature: Dr. Wollaston supposing it to be the seed of a moss; Mr. Brown, a substance belonging to Algae, and nearly related to *Tremella cruenta*, a common British plant; and Mr. Bauer referring it to a genus of Fungi, called *Uredo*. We have lately seen a curious paper upon this subject, by Professor Agardh, of Lund, whose opinions upon all matters connected with the lower orders of vegetation demand deep attention.

"That snow occasionally assumed a red color had long been a fact of which there could be no doubt; and that water was also under particular circumstances stained with red, we have the popular traditions of *flowers of blood*, and water changed to blood, to attest. In the year 1608, a shower of blood fell near Aix, in France, which was examined by Peiresc, and found to be caused by insects; and to the same cause was undoubtedly to be ascribed the bloody rain that fell at Schonen, in 1711, which the learned Bishop Swedberg looked upon as a supernatural phenomenon, and a direct sign of the anger of the Divinity. The red pools which are occasionally met with, even in this country, are generally stained by the presence of an immense number of animalcules, called *Daphnia Pulex*, or *Cyclope quadricornis*. The red stains sometimes seen upon the sea-shore are occasioned by a particular sort of *Fucus*. Professor Agardh proceeds to observe, that the red snow is very common in all the alpine districts of Europe; where it is probably, for the most part, of the same nature as that brought from the North Pole by Captain Ross. Saussure saw it in abundance upon Mount Brevern, in Switzerland, and elsewhere; Ramond found it on the Pyrenees, and Sommerfeldt, in Norway. In March, 1808, the whole country about Cadore, Belluno, and Feltri, was in a single night covered to the depth of twenty centimetres with a rose-colored snow; at the same time a similar shower was witnessed on the mountains of Valtelin, Brescia, Carinthia, and Tyrol. But the most remarkable red-snow shower was that which fell on the night between the 14th and 15th of March, 1823, in Calabria Abruzzo, in Tuscany, and at Bologna, and upon the whole chain of the Apennines. We may add, that both snow and ice were seen stained with red, green, and blue, by the late expedition under Baron Wrangel to the Frozen Ocean.

"With this information before him, Professor Agardh proceeds to consider the nature of this

remarkable substance, which he concludes, with Brown, to be referable to the lowest order of Algae, and to stand as a distinct genus, which he calls *Protococcus*, upon the very limits of the animal and vegetable kingdoms. Saussure, indeed, from finding that the red snow of the Alps gave out, when burnt, a smell like that of plants, concluded that it was of vegetable origin; but he supposed it to consist of the farina of some plant, although he could neither account for its having ascended to such elevated regions, nor mention a plant whose farina was of that color.

"Besides the plant called *Palmella cruenta*, which is similar in its structure to the red-snow plant, other low vegetable productions have been noticed by different authors, as possessing a similar color. Such are the *Lepraria Kermesina*, which, by the way, is considered only a particular state of the red-snow plant itself, and the *Byssus cobaltinea*. These are always found in situations in which they are exposed to the intense action of light, such as vast plains of snow, or masses of glittering limestone. Whence it is inferred that the color of the red snow is attributable to the action of light, modified in some mysterious manner by the nature of the body on which it strikes. In confirmation of which hypothesis, it is remarked, that when the *Lepraria Kermesina* is found under stems, stones, or in crevices of limestone, where light can scarcely gain admittance, its color gradually passes from red to green.

"The only difficulty in the way of this explanation of its nature is in the statements of so many observers, that the red snow falls from the air. But Professor Agardh shrewdly remarks, that all the persons agree that it fell in the night, *which is as much as to say, that no one saw it fall*. He is of opinion that the *Protococcus*, or Red Snow, is called into existence by the vivifying power of the sun's light, after its warmth has caused the snow to dissolve, and accompanied by that incomprehensible power in white snow, of producing a color; and, moreover, that it first attracts the eye when there is a considerable quantity, in the same way that we do not see the color of drops of water till they have accumulated in the ocean."

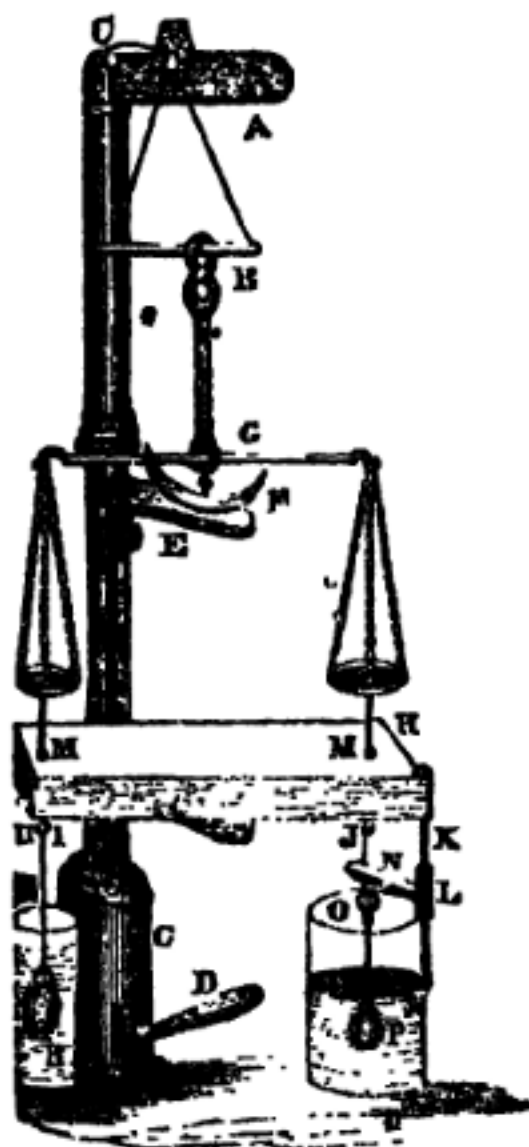
THE BALANCE.

A good balance is necessary, not less for the ordinary commerce of society, than for the purposes of science; and there are few indeed to whom it would be a matter of indifference to know the principles of construction which contribute to the excellence of this simple and useful instrument. We shall, therefore, as briefly as possible, state the properties of a good balance, and also the means by which these properties are to be secured. The characteristics of a good balance are three:—1st. That the beam should rest in a horizontal position when the scales are either empty or loaded with equal weights.—2d. A very small addition of weight put into either scale should cause the beam to deviate from the level, which property is denominated the *sensibility* of the balance.—3d. When the beam is deflected from the horizontal position by inequality of the weights in the scales, it should have a tendency speedily to restore itself, and come to rest in the level, which property is called the *stability* of the balance.* The remarks which follow will guide in the construction of a balance, which shall possess the foregoing properties:—The arms of the beam

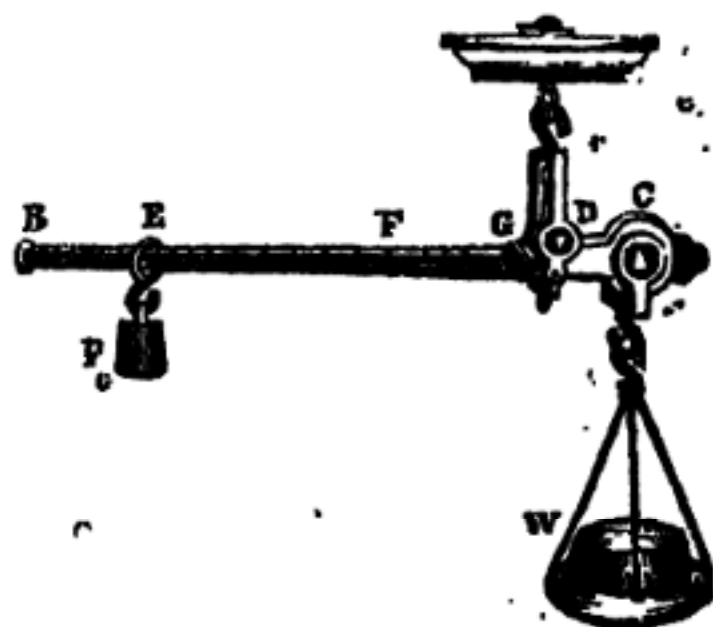
should be exactly similar, equal in weight and length, and as long as possible. The centres of gravity and suspension ought to be in one straight line, and the centre of motion should be immediately above the centre of gravity. The centre of motion and the centres of suspension should cause as little friction as possible, and their axes ought to be at right angles to the line which measures the length of the beam. The centre of motion ought to be a knife-edge; and if the balance requires to be very delicate, the centres of suspension ought to be knife-edges also; and if the centres of suspension be not knife-edges, the rings with which they are formed should be hard, polished, and of an oval form. There are means of testing whether or not these conditions have been observed in the construction of a balance. For if the balance have no tendency to one position more than another, when the scales are either loaded, empty, or off altogether, it is a proof that the centres of gravity and motion coincide. If the beam is disturbed by a small addition of weight to either scale, the arm at the loaded end descending, and having no tendency to resume the horizontal position; then we may infer that the centre of gravity is above the centre of motion; and it is to be observed, that the quicker the descent of the loaded arm of the beam is, the further must the centre of gravity be lowered before the beam will acquire the requisite stability. If it requires a considerable addition of weight in either scale to deflect the beam from the level, we may infer either that there is too much friction at the centre of motion, or that the centre of gravity is too low. If two weights are found to be in equipoise, one being in each scale, when a transfer of them is made, that which was in the one scale being put into the other, then if there be no longer an equilibrium, we may infer that the arms of the beam are of unequal lengths.

Various contrivances have been employed with a view to correct the defects of the common balance. The whole apparatus is not unfrequently inclosed in a glass case, which prevents the heat from expanding the arms unequally, or currents of air from disturbing the equilibrium. A small weight has been made to slide up or down on the tongue, by which means the centre of gravity may be raised or depressed at pleasure; and to regulate the equality of the length of the arms, a regulating screw is employed, by means of which the centre of suspension of either arm may be moved nearer to or farther from the centre of motion. Balances used for delicate purposes, such as for assaying, have the centre of motion suspended; but that centre is fixed on a pedestal, which firmly supports the whole. The hydrostatic balance is another modification of the common scale and beam:—ACC is the stand or pillar of this hydrostatic balance; the lower end of which is fixed in a table. From the top A hangs, by two silk strings, the horizontal bar B, from which is suspended from a ring the fine beam of a balance G, which is prevented from descending too low on either side by the gently springing piece F, supported by the projecting arm E. The strings by which the balance is suspended passing over two pulleys, one on each side of A, are carried over a third pulley on the top of C, through which they descend, and are attached to a small lever at D, by means of which the balance is lifted or depressed when in use. HH is a small board, fixed to the stand, and under the scales, and is moveable up and down on the stand C, and fastened at any part by means of a screw behind. From the point in the middle of each scale hangs by

a fine hook a fine brass wire. These pass through two holes in the table HH. One wire, marked JO, is covered with a case of another wire, which is marked in degrees and minutes, and is about 5 inches long. This passes easily and smoothly through a hole in a bent arm, projecting below the board HH. To the lower end of the wire JO is suspended a weight, and below that a wire with a small brass ball P. To the wire I of the other scale is suspended, by a single horse hair, a large glass bubble.



The balances which we have considered above all require an assortment of weights; and it now remains for us to describe the more important of those balances which require only one weight, but are, nevertheless, capable of determining a great many. Of this description is the statera, or Roman steelyard, represented beneath:—



CB is a steel bar, moving on the fulcrum D, after the same manner as the common balance beam. If the arm CD be one inch long, and the arm DB any convenient length, being divided into inches as at F, and also smaller than the short arm CD, so that when the weight, which is seen at F B, is taken off, and the empty scale hung at E, the bar AB will

be level, and at rest. If now a weight of 2 ounces were put into the scale W, the equilibrium will be destroyed, unless a weight of 2 ounces be hung on the long arm, at the distance of 1 inch from the centre of motion, or 1 ounce at the distance of 2 inches. If a 6 ounce weight be put into the scale W, it will be balanced by 1 ounce at the distance of 6 inches from the fulcrum D, on the long arm, &c., which follows from the principles of the lever; and thus, if the arm D B were 16 inches long, and C D 1 inch, then would 1 ounce weight at B balance 1 pound avoirdupois in the scale F.

The Danish balance is also a steel-yard, but in this the weight is fixed at one end, the article to be weighed at the other, and the fulcrum or support moveable between them.



A modification of the steel-yard has lately been employed with much advantage in taking specific gravities. The bent-lever, or quadrant balance, is represented in the accompanying cut, and depends on principles nearly the same with those of the steel-yard. The article to be weighed is put into the scale A, and the index will rise on the graduated quadrant B, until an equilibrium takes place, when the index will point out the precise weight of the substance in the scale. The greater the weight in the scale is, the higher will the index rise, which corresponds to the moving of the weight on the steel-yard farther from the centre of motion.



Brady's balance is another of the same description. It has been termed a domestic balance by the inventor, from its being peculiarly adapted for family purposes. In the figure below, B C D is a frame of cast iron, which has the greater part of its weight towards A, in consequence of its greater thickness at that part. G is a fixed fulcrum, and F a moveable suspender, which has a scale and hook at its lower extremity. H F I are three distinct points, to which the suspender may be applied, and to which belong respectively the graduated scales of weights seen marked upon the arcs or curves on the lower part of the instrument. When the suspender is applied at I, the apparatus is in equilibrio with the edge, C B horizontal, and the suspender cuts the zero of the scale. If a weight be now placed in the scale,

the whole apparatus turns about G, and the point on the side B C descends, till the equilibrium is again established. The weight placed in the scale may now be read off from the point where the suspender cuts the scale at the lower edge, (which registers to ounces,) and is adapted to bodies whose weight does not exceed 2 pounds. If the weight of the body exceed 2 pounds, but is under 11, the suspender is placed at F, and the weight of the body is shown on another scale, and seen on the same arc. If the weight of the body exceeds 11 pounds, the suspender is hung on at H, and the weights are ascertained in the same manner on the smaller scale up to 30 pounds. The same principle might be extended yet further.



TEST OF VEGETABLE ALKALIES AND THEIR NON-DECOMPOSITION BY PUTREFACTION.

MM. LAROCQUE and Thibierge find, that perchloride of gold is a more decisive test of certain vegetable alkalies, than the double chloride of sodium and gold already employed for this purpose. The following are the colors of the precipitates which it produces with the salts of the annexed alkalies dissolved in water:—Quina, buff-colored; Cinchona, sulphur-yellow; Morphia, yellow, then bluish, and lastly violet; in this last state the gold is reduced, and the precipitate is insoluble in water, alcohol, the caustic alkalies, and sulphuric, nitric or hydrochloric acids; it forms with aqua regia a solution which is precipitated by protosulphate of iron; Brucia, milk-coffee, and then chocolate-brown; Strychnia, canary-yellow; Veratria, slightly greenish yellow.

All these precipitates, with the exception mentioned, are very soluble in alcohol, insoluble in ether, and slightly soluble in water. These precipitates appear to be combinations of gold, chlorine and the vegetable alkali, for their alcoholic solutions treated with tannin give a greenish blue precipitate of reduced gold; if the solution be filtered, and the alcohol be evaporated by heat, a precipitate of tannate of the alkali employed is formed. The liquor again filtered, gives with nitrate of silver a white precipitate insoluble in nitric acid, but soluble in ammonia. Among the reactions of chloride of gold, there are two which to the authors appear to be especially important, they are those which occur with morphia and brucia; they are sufficiently

marked to prevent these alkalies from being mistaken for each other, and also yield pretty good characteristics for distinguishing brucia from strychnia.

MM. Larocque and Thibierge detail also various experiments on the modes of detecting opium proposed by Dr. Christison, and they mention that their results differ much from his. They state that these differences may arise from three causes,—1st, the inequality of the composition of the opium of commerce; 2ndly, the analytical process employed by Dr. Christison, which consisted in decomposing the meconate of lead by sulphuretted hydrogen—this the authors show frequently masks the meconic acid, and that it could only be detected by decomposing the meconate of lead with dilute sulphuric acid; 3rdly, the variable nature of the liquids with which opium is mixed.

The authors have also, as the results of their experiments, arrived at the following conclusions:—

1st. By the aid of reagents it is possible to determine the presence of morphia, strychnia and brucia in substances, which, after being mixed with the salts of these alkalies, have undergone the vinous, acetic or putrefactive fermentation. M. Orfila has already shown that the putrefactive fermentation does not alter morphia.

2ndly. Crystallized iodic acid, or a concentrated solution of this acid, is susceptible of being decomposed by neutral azotized bodies; but a dilute solution of this acid cannot be decomposed by them unless there be added concentrated sulphuric acid, crystallizable acetic acid, oxalic, citric or tartaric acid.

3rdly. Iodic acid should not be employed as a test of morphia without the greatest caution.

4thly. Perchloride of gold produces such effects with the vegetable alkalies, as serve to distinguish morphia, brucia and strychnia from each other.

5thly. The reagents on which the greatest reliance may be placed as tests of morphia are, nitric acid, neutral perchloride of iron, and perchloride of gold.

6thly. By the use of reagents, morphia which has been mixed with beer, soup or milk may be detected.

7thly. It is also easy to prove by reagents the presence of meconic acid in soup or milk, especially when the meconate of lead is decomposed by dilute sulphuric acid.

It appeared to MM. Larocque and Thibierge a subject of some interest to determine by experiment, whether the vegetable alkalies suffered decomposition when in contact with fermenting substances. It had, indeed, been proved by Orfila and Leueur that acetate of morphia suffered no change discoverable by reagents, under these circumstances; and M. Merck detected strychnia, morphia and brucia, after they had been exposed to fermenting animal and vegetable matters during twenty days.

The following experiments were made by MM. Larocque and Thibierge:—

To 3080 grains of blood there were added 5.14 grains of (sulphate of?) brucia; this mixture was exposed to the air from the 2nd of June to the 3rd of August; at this period the blood was putrefying and fetid. It was evaporated to dryness; the residue was treated with boiling alcohol; the solution obtained was filtered and evaporated to dryness, and treated with water acidulated with acetic acid. The solution thus procured was filtered and evaporated to a syrupy consistence. In this state it was reddened by nitric acid, and become of a violet tint by the successive application of nitric acid and perchloride of tin.

Mixtures of the following substances were made

on the 2nd of June:—7700 grains of distilled water, 154 grains of yeast, and 462 grains of sugar. To four such mixtures were separately added 5.14 grains of sulphate of brucia, 5.14 grains of sulphate of strychnia, and 5.14 grains of acetate of morphia. These mixtures soon began to ferment, and when after standing several days the evolution of carbonic acid had ceased, they were evaporated to dryness, then treated with boiling alcohol, and after evaporating the spirit, the residue was treated with water acidulated with acetic acid, and in this liquor, evaporated to a syrupy consistence, the characteristics of the alkali introduced before fermentation were determinable. Some red wine holding hydrochlorate of morphia in solution had been kept in a bottle loosely corked from July 1841 to the 15th of June 1842; the liquid exhaled a strong odour of acetic acid; after treating in the manner above described, and decolorized by animal charcoal, it did not yield crystals, but by evaporation to a syrupy consistence it gave a residue which was reddened by nitric acid, rendered blue by perchloride of iron, was precipitated by tannin, and reduced the chloride of gold.—*Journal de Chimie Médicale.*

FIGURE AND MEASUREMENT OF THE EARTH.

By measuring the meridian curvature of the earth, the compression, and consequently its figure became known. The courses of the great rivers, which are in general navigable to a considerable extent, prove that the curvature of the land differs but little from that of the ocean; and as the heights of the mountains and continents are inconsiderable when compared with the magnitude of the earth, its figure is understood to be determined by a surface at every point perpendicular to the direction of gravitation, or of the plumb-line, and is the same which the sea would have, if it were continued all round the earth beneath the continents. Such is the figure that has been measured in the following manner:—

A terrestrial meridian is a line passing through both poles, all the points of which have their noon contemporaneously. Were the lengths and curvatures of different meridians known, the figure of the earth might be determined. But the length of one degree is sufficient to give the figure of the earth, if it be measured on different meridians, and in a variety of latitudes. For if the earth were a sphere, all degrees would be of the same length, but if not, the lengths of the degrees will be greater, exactly in proportion as the curvature is less. A comparison of the length of a degree in different parts of the earth's surface, will therefore determine its size and form. An arc of the meridian may be measured, by observing the latitude of its extreme points, and then measuring the distance between them in feet or fathoms. The distance thus determined on the surface of the earth, divided by the degrees and parts of a degree contained in the difference of the latitudes, will give the exact length of one degree, the difference of the latitudes being the angle contained between the verticals at the extremities of the arc. This would be easily accomplished were the distance unobstructed, and on a level with the sea. But, on account of the innumerable obstacles on the surface of the earth, it is necessary to connect the extreme points of the arc by a series of triangles, the sides and angles of which are either measured or computed, so that the length of the arc is ascertained with much laborious calculation. In consequence of the ir-

regularities of the surface, each triangle is in a different plane. They must therefore be reduced by computation, to what they would have been had they been measured on the surface of the sea. And as the earth may in this case be esteemed spherical, they require a correction to reduce them to spherical triangles. The gentlemen who conduct the trigonometrical survey, in measuring 500 feet of a base in Ireland twice over, found that the difference in the two measurements did not amount to the 800th part of an inch. Such is the accuracy with which these operations are conducted, and which they require.

Arcs of the meridian have been measured in a variety of latitudes north and south, as well as arcs perpendicular to the meridian. From these measurements it appears, that the length of the degrees increases from the equator to the poles, nearly in proportion to the square of the sine of the latitude. Consequently, the convexity of the earth diminishes from the equator to the poles.

From the mean of the five principal measurements of arcs in Peru, India, France, England, and Lapland, Mr. Ivory has deduced that the figure which most nearly follows this law is an ellipsoid of revolution whose equatorial radius is 3962.824 miles, and the polar radius 3949.585 miles. The difference, or 13.239 miles, divided by the equatorial radius is $\frac{1}{298}$ nearly. This fraction is called the compression of the earth, and does not differ much from that given by the lunar inequalities. If we assume the earth to be a sphere, the length of a degree of the meridian is $69\frac{1}{4}$ British miles. Therefore, 360 degrees, or the whole circumference of the globe, is 24.856 miles, and the diameter, which is something less than a third of the circumference, is about 7916, or 8000 miles nearly. Eratosthenes, who died 194 years before the Christian era, was the first to give an approximate value of the earth's circumference, by the measurement of an arc between Alexandria and Syene.

There is another method of finding the figure of the earth, totally different from the preceding, solely depending upon the increase of gravitation from the equator to the pole. The force of gravitation at any place is measured by the descent of a heavy body during the first second of its fall; and the intensity of the centrifugal force is measured by the deflection of any point from the tangent in a second. For, since the centrifugal force balances the attraction of the earth, it is an exact measure of the gravitating force. Were the attraction to cease, a body on the surface of the earth would fly off in the tangent by the centrifugal force, instead of bending round in the circle of rotation. Therefore, the deflection of the circle from the tangent in a second, measures the intensity of the earth's attraction, and is equal to the versed sine of the arc described during that time, a quantity easily determined from the known velocity of the earth's rotation. Whence it has been found, that at the equator the centrifugal force is equal to the 289th part of gravity. Now, it is proved by analysis, that whatever the constitution of the earth and planets may be, if the intensity of gravitation at the equator be taken equal to unity, the sum of the compression of the ellipsoid, and the whole increase of gravitation from the equator to the pole is equal to five halves of the ratio of the centrifugal force to gravitation at the equator. This quantity with regard to the earth is $\frac{1}{2}$ of $\frac{1}{289}$, or $\frac{1}{578}$. Consequently, the compression of the earth is equal to $\frac{1}{578}$ diminished by the whole increase of gravitation. So that its form will be known, if the whole increa-

of gravitation from the equator to the pole can be determined by experiment. This has been accomplished by a method founded upon the following considerations:—If the earth were a homogeneous sphere without rotation, its attraction on bodies at its surface would be every where the same. If it be elliptical and of variable density, the force of gravity, theoretically, ought to increase from the equator to the pole, as unity plus a constant quantity multiplied into the square of the sine of the latitude. But for a spheroid in rotation, the centrifugal force varies, by the laws of mechanics, as the square of the sine of the latitude, from the equator, where it is greatest, to the pole, where it vanishes. And as it tends to make bodies fly off the surface, it diminishes the force of gravity by a small quantity. Hence, by gravitation, which is the difference of these two forces, the fall of bodies ought to be accelerated from the equator to the poles, proportionably to the square of the sine of the latitude; and the weight of the same body ought to increase in that ratio. This is directly proved by the oscillations of the pendulum, which, in fact, is a falling body; for if the fall of bodies be accelerated, the oscillations will be more rapid: in order, therefore, that they may always be performed in the same time, the length of the pendulum must be altered. By numerous and careful experiments, it is proved that a pendulum which oscillates 86,400 times in a mean day at the equator, will do the same at every point of the earth's surface, if its length be increased progressively to the pole, as the square of the sine of the latitude.

From the mean of these it appears that the whole decrease of gravitation from the poles to the equator is 0.0051449, which, subtracted from $\frac{1}{578}$, shows that the compression of the terrestrial spheroid is about $\frac{1}{573}$. This value has been deduced by Mr. Baily, President of the Astronomical Society, who has devoted much attention to this subject; at the same time, it may be observed, that no two sets of pendulum experiments give the same result, probably from local attractions. Therefore, the question cannot be considered as definitively settled, though the differences are very small.

CUPELLATION, AND ANALYSIS OF SILVER COINS.

CUPELS, which are small porous cups, formed by ramming well washed and pulverized bone ashes into a mould, may be considered as filters, permeable only to certain fluids, or as sponges, which absorb some bodies, but have no action on others. Fused metallic oxides readily penetrate these vessels, but to the metals themselves they are quite impermeable. Hence they afford a ready method of separating those metals which are not capable of change by the combined action of heat and air, from others that are oxidated by their influence. When such mixtures are kept in fusion on them with access of air, the oxides which form, are gradually absorbed by the cupel, and the inoxidable metal is at last left in a hemispherical form on the surface, like a globule of quicksilver on a plate of glass, pure and unalloyed. If the oxides be not fusible by themselves, at the requisite degree of heat, a portion of some other metal must be added, which may promote their fusion. Lead is generally preferred for this purpose: in all cases it is necessary that the inoxidable metal be not volatile, and that it be sufficiently fusible to form a round button; otherwise it would remain disseminated, adhering to the

portion of oxide with which the surface of the cupel is impregnated, and could not be completely collected. The operation is performed by placing the two metals on a cupel, which has previously been thoroughly dried at a red heat, and exposing it for a certain time, in the muffle of a cupelling furnace, to a temperature from about 26° to 35° of Wedgewood's pyrometer.

Since only gold and silver are inalterable, fusible, and fixed at this temperature, they alone can be correctly separated from other metals by cupellation. Platina, and probably other metals, may be separated by cupellation, but they must first be combined with a sufficient quantity of silver and gold, to make them fusible.

Lead and Silver.—Place the cupel under a muffle, and when heated to about 27° of Wedgewood's pyrometer, put the alloy on it. It soon fuses and is covered with a coat of oxide of lead, becomes flattened, gives off fumes, and considerable motion ensues on its surface, which by continual renewing it, assists the oxidation. The lead thus gradually passes to the state of oxide, and the oxide as it forms, and is absorbed by the cupel, except a very small portion, that volatilizes, and occasions the fumes just mentioned. Together with these phenomena others present themselves, not less important to the progress of the assay. The alloy diminishes in volume, and leaves a trace or circular mark on the basin of the cupel, differing in color according to the nature of the metals oxidated. Thus copper gives a darkish brown tinge, iron a reddish one, and tin a white; and we may here observe, that when the latter metal abounds in an alloy, it is necessary to use a greater portion of lead than common for its complete removal.

The alloy which at first was evidently flattened becomes more and more convex, and presents continually increasing shining points. At this period, the lead is almost entirely absorbed, and the cupel must be brought forward towards the mouth of the muffle. There, in a very short time, the shining points disappear. The alloy exhibits all the colors of the rainbow, loses for a moment its lustre, and suddenly becomes brilliant by an instantaneous movement, technically termed *brightening* or *fulguration*. By this last phenomenon we know that the operation is completed. The door of the muffle which has hitherto been removed to a small distance from the mouth, is now to be applied to it, and the silver suffered to become quite solid, before the cupel is withdrawn: when cold, the button of silver is taken off with pincers, the lower part brushed, to remove any particles of the cupel that might have adhered to it, and weighed. Its weight deducted from that of the alloy gives the weight of the lead. It is very essential not to withdraw the cupel from the muffle immediately after the brightening, because the silver by cooling too rapidly would retain too much lead, and also be liable to spring, or shoot out in filaments like fine wire; for at the moment the exterior of the assay solidifies, it experiences such a contraction as to force out a portion of the still liquid metal within, so as to form a sort of arborization on the surface of the button, and it is not only spitted on the cupel, but even entirely out of it. Moreover the assay cannot be considered good, if the button adhere strongly to the cupel, and be not well rounded, brilliant, and crystallized on the upper surface, whilst the lower presents an un-

polished granular white appearance. If the surface be dull and flattened the heat has been too great and a portion of the silver volatilized; on the contrary, if it be brilliant in many points, and present here and there an unpolished white crystalline appearance, have little cavities below, adhere obstinately to the cupel, and yellowish scales remain on the vessel, the heat has been insufficient, and the silver still retains a portion of lead; in either case the assay must be repeated.

Copper and Silver.—The oxide of copper fuses with difficulty; a portion of lead must therefore be added in this analysis.

Suppose the alloy to be examined is that of the French coin, which contains 9 parts of silver and 1 of copper. Put 105 grains of lead on the cupel, placed as before, and heated to the same degree, and when it is melted and its surface bright, add with the tongs 15 grains of the alloy. The three metals almost instantly unite and form a melted mass which presents the same phenomena as the alloy of silver and lead. After the brightening has taken place, it only remains as in the former instance to weigh the button of silver, to know the proportion it bears to the copper. The quantity of lead to be added must depend on that of the base metal in the alloy; for instance, to assay silver plate, whose standard is 0.95, only three parts of lead to one of the assay, are necessary; for a silver alloy of the standard of 0.8, ten parts are required, and for the assay of base coin, whose standard is 0.2, sixteen or seventeen. In what has just been said, the standard of the assay is supposed to be known, when otherwise it must be determined pretty nearly, by a previous trial with about two grains of the alloy and an equal quantity of lead.

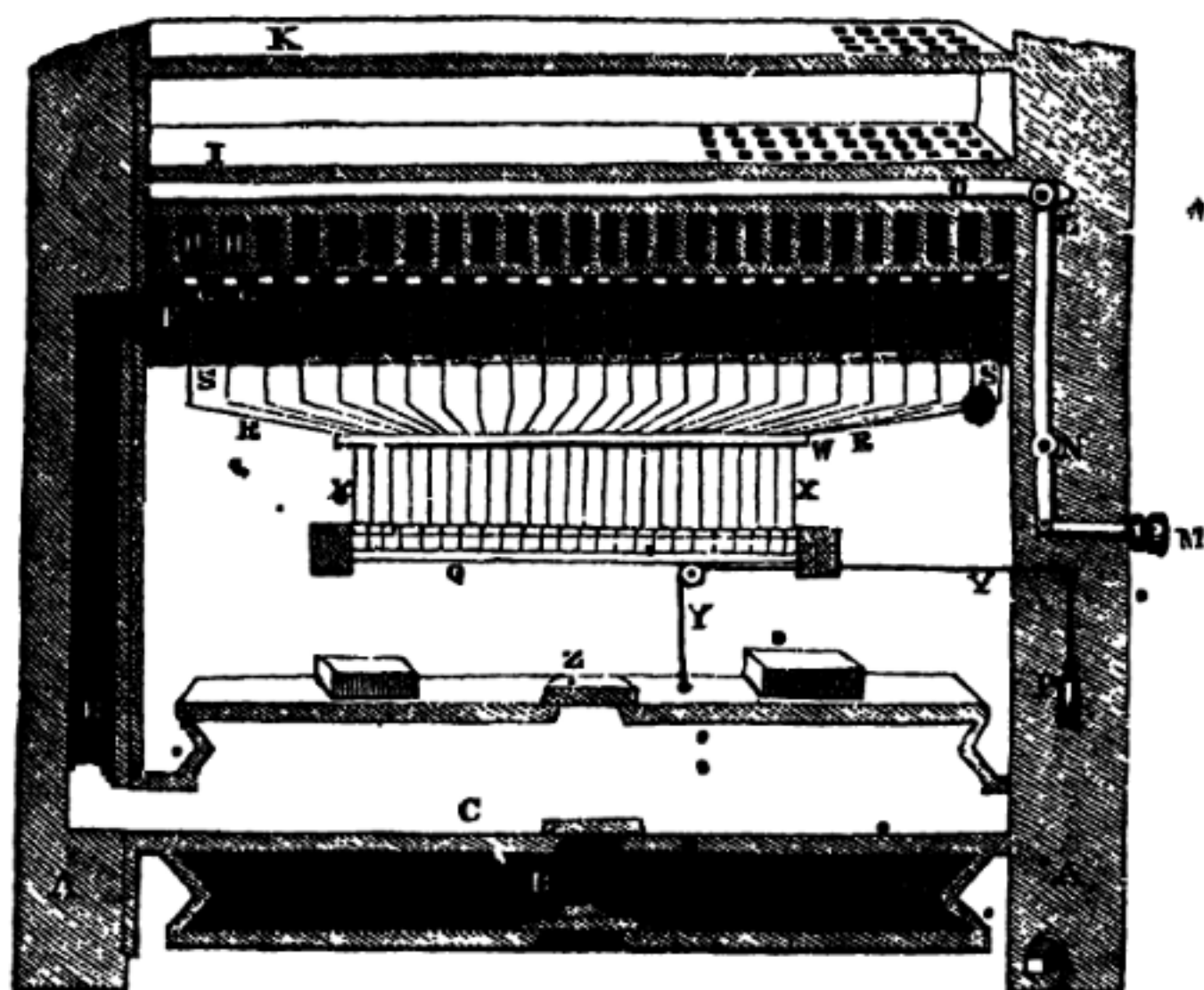
NEW MODE OF FORMING AMMONIA.

THE researches of M. Kuhlmann have shown that under the influence of spongy platina, nitric oxide mixed with excess of hydrogen produced ammonia. On repeating the experiments of M. Kuhlmann, M. Reiset substituted several metallic oxides for spongy platina. The results which he obtained are very interesting, and throw great light on the obscure cause of catalytic action. M. Reiset states, that with an apparatus, consisting of two bottles, each of the capacity of about 60 cubic inches, for evolving hydrogen gas and nitric oxide, and 145 grains of sesquioxide of iron, heated in one end of an analysis tube, he obtained sufficient ammonia to completely saturate 360 grains of commercial hydrochloric acid.

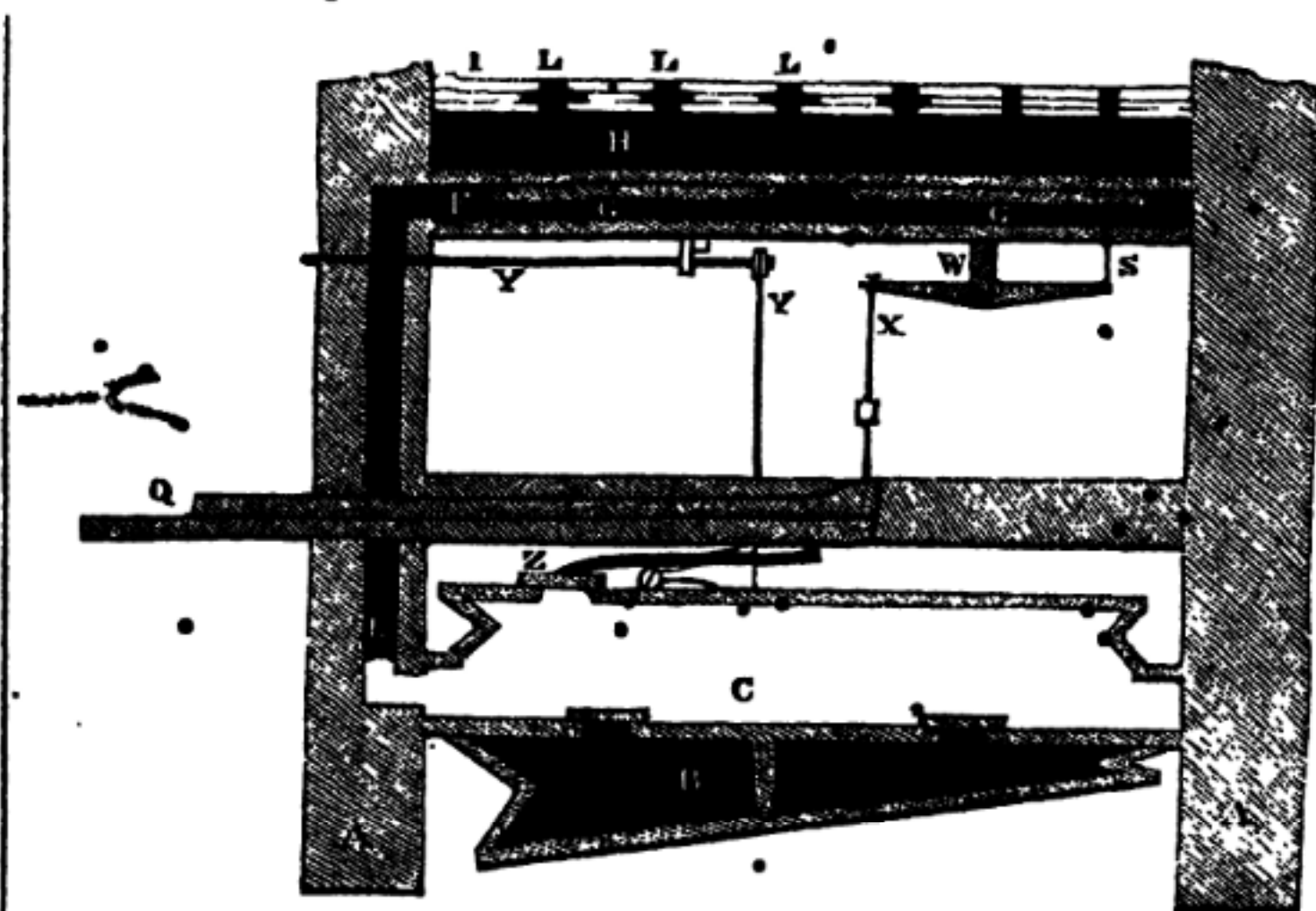
ANSWER TO QUERY.

9. *How are windows frosted or rendered semi-opaque, by a crystallized salt?*—This is very easy to accomplish; all that is necessary to be done, is to dissolve any kind of salt in hot water, so as to make a saturated solution, that is to have it as strong as possible; then wash it while hot with a brush, it will soon cool, and deposit the salt in a crystalline form upon the glass, and when the water has evaporated, the window will be beautifully frosted. You may use for this purpose sal ammoniac, Glauber's salts, Epsom salts, or blue stone; but you should not use any of the salts which are apt to deliquesce or dissolve in a damp atmosphere. Numerous other methods of dimming the surface of windows are given in Vol. 1.

Fig. 1.



• THE ORGAN.



2.

THE ORGAN.

We are not aware that a good description of the structure of the ordinary church organ is to be found in any English work, nor indeed the manufacture of any musical instrument whatever. In the following account, therefore, we depend upon one circumstance only, and that is that we once made an organ of the ordinary size of a piano forte, and capable of being played by both keys and a barrel. Without therefore professing to give the usual method pursued by the trade in manufacturing these noble instruments, we may assist our amateur friends in their endeavours, by a few hints upon the subject, which being the result of our own experience may be depended upon as far as they go.

Every organ must consist of four parts:—1. A bellows to supply wind, a wind chest where that wind is distributed into various channels as required, pipes to receive the wind, and through which it escapes; (its escape producing a sound, and the size and structure of those pipes modifying that sound in note and in tone) lastly of keys and valves, by which the wind is admitted to those channels where it is required. A pegged barrel turned by a handle is only a modification of the keys, and is attended by the same valves as if the keys were struck by hand. All organs, however simple they are, even the bird organs of the shops, must consist of the above parts, but to the larger organs, other parts are added for various purposes spoken of hereafter, but which are all subservient to one or other of the chief parts of the instrument, the bellows, wind chest, pipes, or valves. These we are about to describe, intending that our observation shall apply to an organ of four or five stops, and about the size of a cabinet piano forte, with five octaves of keys, one quite large enough for every purpose of domestic music, for a small concert room, or for a chapel. The outward form of it we must leave to the taste of the maker, and we would advise an amateur to proceed as follows:—

Purchase an old piano, harpsicord, or similar instrument; take out the keys, and the board upon which they stand with the pins which keep them in their place, and use them for your organ; this will save immense trouble, and indeed some cost; if there are too many keys, you may cut away an octave or so, suffering the key board to remain about an inch beyond the keys on each side, and fill up this inch with two pieces of wood reaching from front to back of the key board, which keeps the board from warping and forms sides to the keys; these pieces may be ornamented at the front ends. All the keys are then to be cut shorter toward the back end by six inches, still not disturbing the pins which hold them parallel; then upon these ends glue pieces of wood slanting upwards. A side view of the keys is shown at Q, fig. 2, and the slanting piece of wood is shown immediately below X, at the farther end of Q. The front view of the keys is seen at Q, fig. 1.

The frame of the organ A A in the cuts may now be made; for the size we have described it may be 5 feet 6 inches from outside to outside, the keys measuring 4 feet; from front to back may be 2 feet, and the height 5 feet for the lower frame work; another portion, but made lighter, is afterwards to be added at top to inclose the pipes. If it be preferred, the whole may be made of the height of the room at once, but such is by no means convenient on account of moving the instrument from one place to another

when complete. Let the frame consist of four uprights, 3 inches square each for the corners, with cross bars all round near the bottom; others at about 2 feet high, and a third set at the ends only 4 feet high. To the back and front bars at 2 feet high put two cross pieces to bear the key board, and two side slips upon these to confine this key board to the centre of the instrument, allowing it to draw in and out, but not to have any motion sideways. These two cross bars are shown at the ends of Q, in fig. 1. Slide the keys in till they are inside the front edge of the instrument, and then put a stop on each side to prevent their going in further, then draw them out to 1 inch more than the length of the keys beyond the front, and then put another stop to prevent them drawing out further. The keys will require scarcely any adjustment afterwards, they may be removed till all the rest of the instrument is complete.

The bellows is the next consideration. A front view is seen in fig. 1, a side view in fig. 2. That in fig. 2 represents the lower part of the bellows of two parts; this is not however necessary, but is an advantage in saving a little space beneath. Consider then that this lower part is closed by leather at one end, and opens at the other exactly like a common bellows, but made of a square board, about 1 foot 5 inches wide, and 4 feet 6 inches long, and with a hole in it, covered with a valve like that of the common bellows. All the valves afterwards mentioned must be of the same nature, and may be made of wood covered with some soft substance to prevent a noise, or there may be several smaller ones made of thick leather, in both cases loaded to bring them down quickly. It is immaterial whether the bellows be made to open at the end or at the side, in the figures they are supposed to open or rather lift up and down at the front of the instrument, but in most organs they work from the end. The sides and one end of these bellows should not be made wholly of leather as in the common bellows, but of two pieces of wood which fold together, the joints being covered with sheepskin leather as well as the corners—the woods will therefore, when the bellows are not expanded, shut down close upon each other as at the narrower end of B, fig. 2, or expand as at the other end when the bellows are inflated. In both cuts the upper part of the bellows is shown at C, a square frame work of about 3 inches on the side forms the lower portion; this is fastened to the frame of the instrument by screws, the upper part of it sinks up and down according as it is filled with or emptied of air. The uses of the fixed or stationary part is to attach a square trunk called the wind trunk shown at E, fastened at the side of the instrument, it may be of wood, and 2 inches by 6 internal diameter. The wind trunk reaches from the bellows beneath to the wind chest F at top. The upper chamber of the bellows is loaded with weights, and is furnished with a valve Z, which has a handle and spring seen in fig. 2, and also with a cord Y Y, ending with a small weight hanging quite outside the instrument as at P, fig. 1. Now suppose the lower bellows be worked either by a treadle or lever, as we shall show hereafter, (but which our engraver has accidentally omitted,) the air would upon expanding B fill that compartment; upon compressing B, the air would quit the lower, and occupy the upper compartment by opening the valve C. When B is opened a second time, (that is provided E were stopped up) the valve C would close and the air be retained; a second stroke would fill C still more, and lift up the top board, and so on until the bellows

were expanded to the full size. As the bellows fills, the string Y is lifted up, and consequently the weight P sinks; thus the player always knows whether the bellows be full of air, and the organ blower is able to regulate his labor accordingly; but it is possible that the organ blower may work too hard and burst the bellows by over pressure; to prevent the possibility of this the valve Z is placed, for as soon as the upper board of the bellows rises too high, the handle of Z strikes against the underside of the key board, and the valve is opened. The upper board of the bellows is loaded with weights, and although we have only shown the sides of it to be composed of two folding boards, yet we may use four or six of them, exactly as we see them made in an accordion.

We will now consider the wind chest; this is situated at F in both cuts, it is divided into two compartments, both made of the full size of the instrument between the frame. The upper compartment is seen at H, and is about an inch deep, and divided back and front into as many compartments as there are keys, by thin pieces of wood put from sides to side; the sides, ends, and pieces being all fixed and perfectly air tight with the top, which ought to be a thick oak board first screwed to the side, the sides having a number of channels first cut in them, and then the thin pieces glued in the channels. As the whole frame is 2 feet wide, taking out the thickness of the corner pieces, the space left will be 18 inches for the width of the wind chest, enough for four or five stops; but these we have scarcely come to yet. The glue of the wind chest being quite dry, and the whole perfectly air tight, for this is most essential, we are to turn it up, with the channels uppermost and plane all quite smooth and even, then turn it the other way upwards, and plane the top quite smooth also. Next prepare a piece of oak, $\frac{1}{4}$ inch thick in the rough, and plane it down till quite smooth on both sides. It must be 4 inches longer than the wind chest, and 2 or 3 inches wider; cut this into four strips for four stops, or five strips for five stops, each strip $2\frac{1}{2}$ inches wide; lay these at equal distances along the top of the wind chest, and measure the space between them, cut other strips off the same wood to fill the spaces, make them all with perfectly parallel edges, glue on the strips last cut off thus:—First glue on the middle one and fasten it with small brads; then cleaning the glue well from the edges, lay along close to it one of the draw slips as first cut; this is not to be fixed, but the next slip is, keeping it as tight as possible, so that the draw stop shall have no play; thus put on the whole of them, clean the glue well off and let them dry, cut off the projecting ends of the fixed pieces but not of the others. Next you must have a thick oak board to cover the whole, and of the size of the wind chest, plane it smooth, and put it over the pieces which have last been glued on, fasten it there by several screws, but previously to that rub black lead over the sliders, and also the grooves which receive them, and see that they slide along easily and evenly, and paste a thick paper over each fixed piece, and see if the sliders move along easily when the upper piece is fastened down; if they do, this part is finished, if not, they must be scraped or planed until this is the case; one of these sliders is supposed to be at O, fig. 1, the upper thick board at I.

While these upper parts are all fixed together, and the sliders are in their place, and made to come even at one end of the box, or if the draw stops are to draw at different ends of the instrument, some

must be even at one end, and the rest at the other, the projecting part being at the end where they are to draw; you are to turn the wind chest upside down, and bore holes from the inside with a centre or other clean cutting bit of about $\frac{1}{4}$ of an inch in diameter, quite through the top of the wind chest, the slider and the upper board; and there are to be as many holes as there are sliders in each groove, as is shown in one part of I. Then separate the upper board, mark the sliders 1, 2, 3, 4, and also the grooves they fit into with corresponding numbers. Next take a red hot wire of the size of the holes, and burn every one of them so that all the holes shall have clean edges on both sides of each board they go through, and at that part which forms the upper side of the upper board, drill the holes to a taper form, by a rose bit of $\frac{1}{4}$ an inch in diameter, for the conical end of the organ pipes afterwards to be described to fit into. All this part may now when put together again be considered quite complete. We will now before going further show the action of the stops; when the slider is in its place above described, there will be a free communication from the wind chest upwards through every hole, and supposing that there were pipes placed along the various holes over one slider, for example, open diapason pipes; and wind were forced through these holes, the pipes would speak or sound; but supposing the slider were drawn forwards $\frac{1}{4}$ an inch or so, the holes in that slider would no longer coincide with the holes in the wind chest beneath and the board at top, but the communication be cut off with all those pipes; this is seen at L, fig. 2. In fig. 2 we have shown six stops, four of them closed and two open. The method of drawing the stops out is seen at N L, fig. 1. L is a wooden lever fastened any where that is convenient within the frame work. It turns on the centre M, and is pushed in by drawing M forward. In the state in which it is shown, it is supposed that all communication with the row of pipes is stopped, and that they are to be opened by pulling out the knob M, which has the name of the stop upon it, so also for the other stops, the lever requisite to each being bent according to the required position of the knobs, and although we have shown the stop to draw out at the side of the instrument at M, yet they may with more convenience be made to draw from the front, as they are then under the immediate eye and hand of the player. As this paper has already extended to our usual length, we will postpone the subject of the pipes, the lower part of the wind chest, the valves, and their connexion with the keys till another time; making only one observation further, relative to the wind trunk, which is, that in order it may not be in the way of the draw stops, should be toward the back of the instrument.

(To be continued.)

THE BINARY THEORY OF SALTS.

THE numerous and important class of bodies called salts are usually considered as being what is termed bi-binary, or secondary compounds; that is, the combination of two bodies, which are the primary compounds, and are known by the names of the acid and the base, both of them being compound bodies; consisting in general of two, but sometimes more, elementary substances. As an example, sulphate of soda may be taken, in which, as commonly viewed, 1 equivalent of sulphur (S=16,) and 3 of oxygen (3 O=24,) unite to form the primary compound

sulphuric acid ($\text{SO}_2 = 10$) and 1 equivalent of the metal sodium ($\text{Na} = 24$), combined with 1 of oxygen ($\text{O} = 8$), constitutes an equivalent of the base soda ($\text{NaO} = 32$.) These two primary compounds by their union forming the well-known salt, sulphate of soda, which is generally combined with 10 equivalents of water, and called, in common parlance, Glauber salt.

Salts, when considered as constituted in this way, are usually divided into four classes. 1. The oxy-salts; this order includes no salt, the acid or base of which is not an oxidized body. 2. The hydro-salts; this class includes no salt, the acid or base of which does not contain hydrogen. 3. The sulphur salts; this order contains no salt the electro-positive or negative ingredient of which is not a sulphuret. 4. The haloid-salts; this class includes no salt the electro-positive or negative ingredient of which is not among the bodies called by Berzelius halogenes, comprehending chlorine, iodine, bromine, and some of the organic compound radicals. The latter order, however, seems hardly entitled to take rank as a class of salts, (viewing them as constituted according to the theory we have been explaining,) as they appear to be essentially primary, simple binary, compounds only.

Such has hitherto been the generally received notion of the composition of saline bodies, but within the last few years it has resulted from the researches of several eminent chemists that their attention, and more especially that of our talented countryman, Professor Daniel, has been directed to the truthful excellence, and consequent revival, (in a shape suited to the advanced state of chemical science,) of certain profound views of the constitution of salts, first suggested by Davy, in regard to chloric and iodic acids, and their salts, and afterwards applied by Dulong to the salts of oxalic acid. This view, which is denominated the binary theory of salts, may be briefly enumerated as follows: viz. That all the salts, instead of being secondary, are really primary, binary compounds; and the acids, which enter into their composition, hydrogen acids. The salts, therefore, consist not of an acid and an alkali, but of a body, called the salt radical, and a metal; and this theoretical statement is supported by many facts and analogies; the principal of which we shall now proceed to point out.

The fundamental proposition of this theory, (and which constituted Davy's original observation,) is, that all the oxygen acids, in their free or active state, contain hydrogen; such hydrogen being usually considered as part of the water, with which nearly all the acids are, when isolated, combined, and from which it is impossible to separate most of them without causing decomposition. Thus our previous illustration, sulphuric acid, which in its strongest free state contains 1 equivalent of water, instead of being composed of $\text{SO}_2 + \text{H}_2\text{O}$, as hitherto supposed, is on this theory constituted of $\text{SO}_2 + \text{H}$; and as we cannot obtain sulphuric acid in any more concentrated state, (for it will be presently shown that the so-called anhydrous acid is in reality any thing but an acid, such a view of its constitution cannot be contradicted; and, if it give a better explanation of phenomena which occur with this acid, ought to be supported.

In order to further simplify the theory, Daniel, and the other chemists who have adopted his views, imagine that the elements of the acid are combined into a compound radical and hydrogen. Thus the hydrated sulphuric acid, $\text{SO}_2 + \text{H}_2\text{O}$, or $\text{SO}_3 + \text{H}$,

is represented as an hydrogen acid, by transferring the oxygen of the water combined with it to the SO_2 to form a new radical SO_3 , which is supposed to have a strong affinity for, and to be in direct combination with the remaining atom of hydrogen, forming the liquid acid, which thus becomes the true primary compound, and not a diluted acid. This sulphate radical it is proposed to designate sulphat-oxygen; and the name of the old hydrated sulphuric acid will therefore be sulphatoxide of hydrogen, and when a salt is formed, by saturating it with a basic oxide, the hydrogen of the acid is replaced by the metal of the base, and the oxygen of the latter forms water with the hydrogen so displaced. Thus in the case of sulphate of soda the acid and salt will be named and denoted, on the two views of their constitution in the following manner:—

OLD VIEW.

Hydrated sulphuric acid, or sulphate of oxide of hydrogen, (water)	} $\text{H}_2\text{O} + \text{SO}_2 = 49$
Sulphate of soda, or sulphate of oxide of sodium	
	} $\text{NaO} + \text{SO}_2 = 72$

NEW VIEW.

Sulphatoxide of hydrogen	$\text{H} + \text{SO}_3 = 49$
Sulphatoxide of sodium	$\text{Na} + \text{SO}_3 = 72$

So that to form a salt with this acid, in the place of supposing a union between it, as an acid and a base, the process is considered as one of substitution only.

From a comparison of the above two sets of formulæ for the same substance, the strictly binary character of the latter view, in contradistinction to the bi-binary one of the other, is apparent.

One class of acids, the hydrogen acids, and the salts which they produce with alkalis, are unquestionably binary compounds, and were assumed by Davy as the types of acids and salts in general. Thus hydrochloric acid is composed of two elements, chlorine and hydrogen, and with soda it is admitted on all hands that chloride of sodium and water are formed, the hydrogen of the acid being replaced by sodium in the salt formed. Hydrocyanic acid is another hydrogen acid, of which cyanide of sodium is a salt. In general terms a radical, (which may be either simple or compound, like chlorine or cyanogen,) forms an acid with hydrogen, and a salt with sodium, or any other metal.

(To be continued.)

GALVANIC DEPOSITIONS ENGRAVINGS, &c.

BY M. DAMBERGER.

THE method I have adopted for producing plates from printed copies is the following. of my own devising:—First procure a recently printed impression of the engraving, and press very tight on a clean plate of polished copper, by which operation the greatest part of the printing ink is transferred from the paper to the metal. Very fine filings of copper, or, what is still better, the powder of that metal precipitated from any of its salts by means of a plate of iron or zinc, must now be evenly sprinkled on the plate, and then brushed lightly over with a fine soft brush: the powder attaches itself to the inked, but not to the other parts of the plate, provided the process has been conducted properly, and by that means raises the picture above the general (flat) surface.

The plate may be now considered as a mould or matrix, and is intended to receive a deposit of

voltal copper, for which object it is placed in a decomposition cell by the side of a similar sized plate of sheet copper of $\frac{1}{4}$ of an inch in thickness. When these are connected by means of wires with the elements of a Daniel's battery, the acidulous solution or sulphate of copper which fills the cell is immediately decomposed; and the copper affixes itself to the matrix, the opposite plate being, at the same time, proportionally corroded. It scarcely needs to be added that the mould is to be attached to the wire that comes from the zinc element of the voltaic battery. This method furnishes a ready means of multiplying and copying engravings, with great facility, and is particularly applicable to the production of the common varieties of prints. The whole of the impressions from plates thus formed are reversed in respect to right and left, but the shades, &c. remain as in the originals. Drawings might be by a similar manner transformed into plates capable of having impressions taken therefrom. This can be accomplished by painting with an oleaginous mixture, either on the plate or on paper, (the latter requiring, of course, to be transferred,) and then sprinkling the plate with a metallic powder in the manner before described. If the painting be executed on the plate, oil varnish may be used; it should be laid on very thin and even, beginning with the lightest shades, and going on progressively to the darkest ones: it will also be an improvement, in this case, to use fine copper filings, carefully sifted through sieves of various degrees of mesh, the finest kind being required for the lightest tints, while the roughest are the darkest and boldest touches of the picture: by manipulating in this manner a very superior effect will result.

If the impression of which it is desired to have a copperplate, should not have been quite recently printed, but perhaps done a few months before, the best way is first to thoroughly cleanse the matrix-plate with dilute nitric acid, and when dry, to transfer thereto the print, which should be previously exposed to the vapor of heated oil of turpentine, or a mixture of ether and oil of lavender, in order to soften the ink; it must now be sponged over with gum-water, and a lithographic roller passed over it, so as to cause the lines of the picture to take up an additional quantity of ink: when the gum has been washed off and the plate dried, the application of the copper powder will produce the desired effect. Although I have mentioned that the decomposition ~~cell~~ and voltaic battery are to be employed, yet if such things be not at hand, the single cell apparatus will answer very nearly as well; but I must say that I would give a preference to the former arrangement, as the action goes on in a far more regular manner, the deposit must consequently be much firmer, and the energy of the action can be much more easily and correctly regulated.—*Philos. Mag.*

LIME AND LIMESTONE.

Lime is a substance which never occurs naturally in a pure state, being always combined with some other body, as well as mechanically mixed with impurities of various kinds. The usual state in which it is found is as an earthy salt, called, when crystallized, calcareous spar; and, when massive, limestone, being combined with carbonic acid in the proportion of about 54 of lime to 46 of carbonic acid in the 100 parts.

The natural state of carbonic acid, under the ordinary atmospheric pressure and temperature, is

a gas, or permanently elastic fluid; and as this gas is but sparingly soluble in water, it follows that when we put a piece of limestone in a glass, and cover it with water, and then add any substance capable, by combining with the lime, of separating the carbonic acid, this latter will rise through the water in a stream of bubbles, producing that appearance which the chemist calls effervescence. Most acids, when dissolved in water, will separate carbonic acid from lime in the way just described; and hence we are furnished with an easy test for distinguishing limestone from sandstone, and from other usually occurring rocks, by its almost entire solubility, accompanied by effervescence, in cold dilute muriatic, or nitric acid; the proportion that remains undissolved indicating with considerable, though not perfect, accuracy, the amount of impurities. Every kind of limestone is not equally adapted to the use of the bricklayer; and, as these differences depend partly on mechanical and partly on chemical properties, it becomes necessary to describe somewhat in detail the principal varieties of limestone, as far as their economical use is thereby affected. With this view they may conveniently be arranged into four families.

The first includes those limestones which are, for the most part, of a pale color, and burn to a white lime, containing very little foreign matter. Of these, the purest is white granular or statuary marble, which contains hardly any impurities, except a little silicious earth. This is actually used by the chemist, when he wants a lime purer than usual; but as, when heated, it is very liable, on account of its granular crystalline structure, to fall into a coarse powder, it is manifestly incapable of being burnt in a common limekiln, and therefore is of no use as a material for mortar.

White chalk is another of this family, which, on account of its softness and porousness, is easily quarried, and requires less fuel and a shorter time for its burning than common gray limestone does. It has, however, this disadvantage, namely, that the cores or centres of those pieces that have been only superficially burnt, are easily broken down with the back of a spade, and therefore are often mixed up with the other ingredients of the mortar, instead of being scrupulously rejected, as they ought to be. Oolite is another limestone of this family, and derives its name from the small round grains or concretions of which it is principally composed, and which were formerly supposed to be the eggs of fish in a petrified state. In hardness, and other qualities, it holds a place intermediate between chalk and gray limestone.

Gray limestone itself, includes all those beds in mountain limestone and in transition limestone which, with a structure passing from scaly into compact, are decidedly harder than the preceding, and require the assistance of gunpowder to detach them from the quarry, unless where they occur in very thin beds. They take, in burning, a longer time and somewhat greater quantity of fuel than the preceding, and are often mere aggregates of corals and other organic remains. The amount of impurity, chiefly sand and clay, rarely exceeds four or five per cent, and the darker varieties usually furnish the whitest lime, showing the color to be chiefly carbonaceous. The second family includes the swinestones and bituminous limestones; the first name being given to them from the fetid smell, like that of a pig-sty, produced by rubbing them against any hard substance. Their color is dark brown, passing

into black; all the varieties of black marble being of this kind. When heated red-hot, the carbonaceous coloring matter begins to re-act on the carbonic acid, converts it into another gas called carbonic oxyde, which, having no attraction for lime, flies off, leaving behind the lime itself, of a snow-white color, and rendered perfectly caustic, in a shorter time, and by a less expenditure of fuel, than is required for any other kind of limestone. Being, when burnt, more porous than any other of the compact limestones, it falls down into an exceedingly fine powder, by the action of water, or on exposure to the air; a quality which renders it particularly valuable to the farmer, as well as to the builder.

The third family is that of the magnesian limestone. Its chief repository in this country is that very extensive formation called the new red sandstone, which, in the natural series, lies immediately above the coal measures; here it occurs in thick beds, as well as occasionally in the mountain limestone. Its color is sometimes reddish, but usually is of a pale yellowish brown. Many varieties have so greatly the aspect of fine grained sandstone, that they were for a long time considered as such; but a minute inspection will show that they are an aggregate of small rhomboidal crystals, which on analysis prove to be compounds of carbonate of lime and carbonate of magnesia, the relative proportions of which, though subject to considerable variation, may be stated at about three-fifths carbonate of lime, and two-fifths carbonate of magnesia. If a piece of this limestone be put into cold dilute nitric acid, it will dissolve very slowly, with hardly any sensible effervescence, although in hot acid the effervescence will be as vigorous as with common limestone. When burnt to lime, it retains its causticity for a much longer period than common lime does; and, therefore, no doubt modifies to a certain degree the properties of the mortar into the composition of which it enters, although its precise action has hitherto been very little investigated.

The fourth and last family includes those limestones which contain in their composition so large a proportion of iron and clay as to enable them to form cements, which have the property of becoming solid under water, and, therefore, are peculiarly valuable in subaqueous constructions. One of these is the gray chalk, or chalk-marl. The bottom bed of the great deposit of chalk is considerably thicker than the upper ones, and contains no flints; in color it is of a less pure white or gray, and is considerably harder than the upper chalk, so that many parts of it make a tolerably good building stone. In composition it is not uniform; the proportion of slightly ferruginous clay that it contains, notably increasing from the top to the bottom of the bed: the lower parts moulder by exposure to weather; and the lowest of all not only moulder, but are more or less slaty in structure; that is, are in the state of true marl. That part of the gray chalk which is used for water cement, contains various proportions of clay, from 6 or 8, up to about 25 per cent, and after burning has a pale brownish yellow color. It is known in the London market by the name of Dorking lime, there being very extensive quarries of it near that town, as well as at Merstham and Halling. Another and still more valuable variety of limestone for water cement is the blue limestone, which is generally of a dark dove color, and of a dull earthy aspect; by long exposure to weather it becomes, superficially at least, of a liver brown, and when

burnt into lime is of a buff color. It forms occasional beds in the transition and mountain limestone deposits, but constitutes nearly the whole of the lias limestone. This latter is one of the most remarkable of the English strata. Its geological position is between the loweroolite, and the new red sandstone. It passes obliquely through the country in a direction from N.E. to S.W.; from the sea coast at Whitby, to the cliffs at Lyme-Regis in Dorsetshire, on the British channel. In its course southward it passes to the east of York, and crosses the Humber near the junction of the Trent and Ouse; thence it passes through the western edge of Lincolnshire, and traverses the counties of Nottingham, Leicester, Warwick, and Gloucester; its breadth in this part of its course being pretty uniformly about six miles. Hence the main body proceeds in nearly a southerly direction through Somersetshire to the coast of Dorset, while a broken line of the same skirts along the southern shore of the Bristol channel as far as Watchet, and appears on the northern shore in detached patches in the counties of Monmouth and Glamorgan. The entire thickness of this deposit is perhaps about 250 feet; the middle part consists of beds of blue limestone alternating with blackish slaty marl; the upper and lower parts being less calcareous than the middle, and composed chiefly of beds of marl, in which are harder masses of a compressed globular figure, less clayey than the slaty marl in which they are found, but less calcareous than the blue limestone. The quarries of Watchet, Aberthaw, and Barrow, in Leicestershire, were long celebrated for the excellent water lime which they produce, before it had been ascertained from geological surveys that they are only on different parts of the same deposit. From an analysis by Mr. Smeaton of the blue limestone of Watchet, Aberthaw, and Bath, the proportion of iron and clay in each appears to be the same, or about 11½ per cent. The blue lime of Barrow, according to Mr. Marshall, contains about 14, and according to Smeaton, 21·3 per cent of the same ingredient, and that of Westbury, 9 per cent. The lias limestone used by the London builders is brought from Lyme-Regis, but is little used in the metropolis, being about 25 per cent dearer than Dorking lime, the difference in cost depending, in part at least, on the longer time and greater quantity of fuel required in burning it.

The balls which I have mentioned as occurring in the upper and lower beds of the lias formation are not peculiar to it, but appear to be formed of small deposits of bluish slaty clay that contain carbonate of lime, but not sufficient to separate from the rest of the ingredients into distinct beds of limestone. Thus, in several of the beds of blue clay that lie above the chalk in that district called the London Basin, are to be found layers of compressed spheroidal balls, known by the name of septaria, or cement stones. The outer part of them consists of obscurely slaty concentric layers, with an excess of clay, and which peel off by long exposure to the air; the interior part is more compact, and is not unfrequently divided into nearly cubical pieces by cracks generally filled or lined with calcareous spar. They may be observed in the cliffs of London clay that form the eastern coast of the island of Sheppy, also in the low cliff at Southend, at the mouth of the Thames; and they have been dug up wherever excavations have been made in the London clay, as at the archway road at Highgate, and in the deep cutting and tunnelling that was made for the London and Birmingham railway, near Primrose Hill.

Of late years these stones, burnt and reduced to powder, have been very extensively used in all water building and other masonry requiring particular care, with such success as to have entirely superseded the employment of puzzolana, and of Dutch terras. With this concludes our survey of the calcareous raw materials employed in the construction of cements, in which we began from the purest kinds of limestone, and terminated with those that contain the smallest proportions of carbonate of lime.

FORM OF GREENHOUSES.

GREENHOUSES may be of various forms and shapes, but the further that the parts deviate from straight lines, the more will the expense be increased, on account of the waste of material and extra labor in workmanship. Circular, domed and curvilinear houses are all liable to the above objection, and, in addition, are not easily ventilated. The ordinary form of straight roofs, or that of a span roof, is the most economical and fittest for all purposes. It may not be unimportant if we state briefly some opinions of much greater weight than our own on this subject, both for and against such forms of roofs.

The intelligent Thomas Andrew Knight, Esq., observes, that the plan recommended by the late Sir George M'Kenzie, Bart., for forcing houses, although exceedingly interesting, "contains some defects which cannot be obviated without deviating from the spherical to the spheroidal form, which Sir George states to be objectionable, on account of the great nicety required in the workmanship. On making a few trials to ascertain the variety of forms which might be given for hot houses, by taking the different segments of a sphere, I soon became perfectly satisfied that forcing houses, of excellent form, for almost every purpose and of any convenient extent, might be constructed without deviating from the spherical form, and I am now," says he, "perfectly confident that such house will be erected and kept in repair at less expense, will possess the important advantage of admitting more light, and will be found much more durable than such as are constructed according to any of the forms that have been hitherto recommended. By employing a small segment of a large sphere, as low and as wide a forcing house as can be wanted for any purpose, may be readily obtained. Instead of the half, a sphere of 30 feet diameter, let the half of one of fifty be chosen, and from the base of this cut off 35°, and from the summit 15°, and the following proportions for a forcing house will be given. Its height, (including 18 inches of upright, opaque front, opening as shutters), will be 12 feet; its width in the centre, 14 feet, and its length very nearly 40 feet; and there are few purposes for which a house, constructed according to some of the intermediate forms, between that above mentioned and the accumulated semidome, will not be found extremely well adapted."

Curvilinear-roofed hot houses of all shapes, we ought to observe, require very great care in regulating the effects of solar heat, particularly those that are constructed of metallic matter. From the experiments made in the gardens of the London Horticultural Society, and published in the "Transactions" of that Society, Vol. VI. p. 379, we learn that "in the first year of its trial, the roof was permitted to be wholly exposed to the action of the sun, but it was found impracticable to regulate its

temperature under such circumstances, although the house was ventilated, not only by means of apparatus in the front and back walls, but the two ends of the house were so contrived that they will open almost entirely when necessary, so that a current of air may be introduced both at the ends and sides. The temperature was indeed kept regular during the night by means of fire heat without difficulty, but in the day time it was found impossible to do so. When there were alternate changes from a clouded to a bright sky, the action of the sun's rays was so sudden, that the thermometer of the house was raised too high before the speediest supply of air could be given; and when there was a whole day of continued sunshine, with a calm atmosphere, as often happened in the early part of the season, the house could not, with all the ventilators in operation, be kept within 10° of the temperature required. After this experiment, it was determined to counteract the irregularity of temperature by providing the roof with an awning of canvass, which might be drawn over the glass or removed, as should be advisable. This produced very beneficial results. The experiment, therefore, seems to prove, that although with attention it may be practicable to force some description of fruits, perhaps with almost as much success as in a wooden house, yet that others are not to be made to bear fruit, and that upon the whole, a house constructed with wood is much better adapted to the purpose of forcing, than one with a curvilinear iron roof."

Not only are curvilinear metallic hot houses more difficult to manage in regard to temperature, than wooden and straight roofed houses of the same size, but they are also, from the same causes, more difficult to maintain in a proper state of humidity. This has also been satisfactorily proved in the garden of the Horticultural Society, from experiments made by Daniell's hygrometer, the result of which is "that in curvilinear houses during the summer, the degree of atmospheric moisture, which appears to be most suitable to tropical vegetation, may be settled at about 860, the temperature being from 80 to 87° of Fah., and the transmission of light such as has been already stated to take place through an iron roof. And it has been satisfactorily ascertained, that the nearer the temperature and humidity of a stove approximates to these degrees, the more favorable is the artificial climate found for bringing the powers of vegetation into vigorous action. It can also be stated, that unless such a degree of humidity is carefully maintained during the summer months in a hot house constructed of iron, such a house will be found more rapidly prejudicial to the health of plants than one constructed of wood, because its atmosphere, if left to itself, would become more dry, and the plants would exhibit all the symptoms of aridity."

Our own experience in metallic hot houses has long ago satisfied us that they are, in the above respect, as well as in others, inferior to houses constructed of wood; and we are only surprised after the opinions of competent judges have been so frequently laid before the public, that houses of curvilinear forms, and of metallic materials, should not have been, long before now, entirely expelled from our gardens.

Much has been said of late years, and we believe to very little purpose, upon the angle which the roof of a hot house should present to the horizon, and indeed we find that this subject had attracted the attention of the celebrated Boerhaave. Philip Miller

applied it to plant stoves, and Williamson, Knight, the late Sir George M'Kenzie, and others, have also directed their attention to the subject. The "Horticultural Transactions," and the "Encyclopædia of Gardening," contain a variety of opinions upon this subject; but so far as we know, few hot houses have been erected with much attention to the nicety of these theories. Most hot houses are built to about an angle of 45° or thereby, and we hear of few complaints against such structures. Indeed, this angle appears to be the least that will effectually drain off the water, and appears to us to be exceedingly well calculated for general purposes.

The following has been laid down as data to determine the angles of the roofs of hot houses by Wilkinson, in the "Horticultural Transactions," Vol. II. p. 237: "The angle contained between the back wall of the forcing house and the inclined plane of the glass roof, always equals the sun's altitude when his rays fall perpendicularly on that plane, provided that the inclination of the plane to the horizon be at an angle not less than 28° , $2'$, nor greater than 75° . Within the above limits, the sun's rays are perpendicular twice in the year, once in going to, and once in returning from the tropics." Hence, then, having determined in what season we wish to have the most powerful effects from the sun, we may construct our houses according to the following rule:—Make the angle contained between the back wall of the house and its roof, equal to the complement of latitude of the place, less or more the sun's declination for that day on which we wish his rays to fall perpendicularly. From the vernal to the autumnal equinox, the declination is to be added, and the contrary. Thus, to apply those principles to the slope of roof recommended by Knight, for ripening grapes in July, we have, say at London,

Latitude of London..... $51^\circ 29'$
 Sun's declination on the } $17^\circ 31'$
 21st of July..... }
 $33^\circ 58'$ or 34° nearly.

As we want the genial warmth of the sun most in spring, therefore, for general purposes, that construction would perhaps be best which gives us the greatest quantity of perpendicular rays then. If the inclination were 45° the sun's rays would be perpendicular about April the 6th, and September the 4th; and as the rays would vary very little from the perpendicular for several days before and after the 6th of April, and the 4th of September, the loss of rays arising from reflection would, as appears from the annexed table, be nearly a minimum. Even at the winter solstice, the loss by the obliquity of the angle of incidence would be only two in one thousand more than when the rays fall perpendicularly, as appears by Bouguer's table of rays, reflected from glass, of one thousand incidental rays. When the angle of incidence is

$87^\circ 30'$	584 are reflected	60°	112 are reflected
$85^\circ 0'$	543	50°	57
$82^\circ 30'$	474	40°	34
$80^\circ 0'$	412	30°	27
$77^\circ 30'$	356	20°	25
$75^\circ 0'$	299	10°	25
$70^\circ 0'$	222	1°	25
$65^\circ 0'$	157		

Ency. of Gard.

Painting.—Every plant structure should be painted at least three times before it is finished, so as to

prevent the timber from imbibing moisture, which if once in, and the paint laid over it, it cannot escape, and as a consequence, decay, under the general denomination of dry rot, commences, and going on unobserved, soon reduces the fabric to a state of ruin. Upon the same principle, the best quality of timber, and that well seasoned, should only be used. More mischief arises from a want of attention being paid to these two points than from all other evils put together.

In regard to color, much may be left to fancy, at least for the last coat. White is the most common, but is soon stained, and looks dirty; green is very popular, but is the most expensive in the first instance, and requires to be oftenest renewed, as it is less durable, and sooner fades and looks bad. A soft stone color is at once the cheapest, the most durable, and harmonizes best with garden objects.

Hot houses should be painted at least once in three years; but much caution is required to prevent the cure from being worse than the disease, for if the rafters and sashes be damp before the painting is commenced, the damp within them will be prevented from escaping, and decay will be the consequence.

EXAMINATION OF FUSED CHARCOAL.

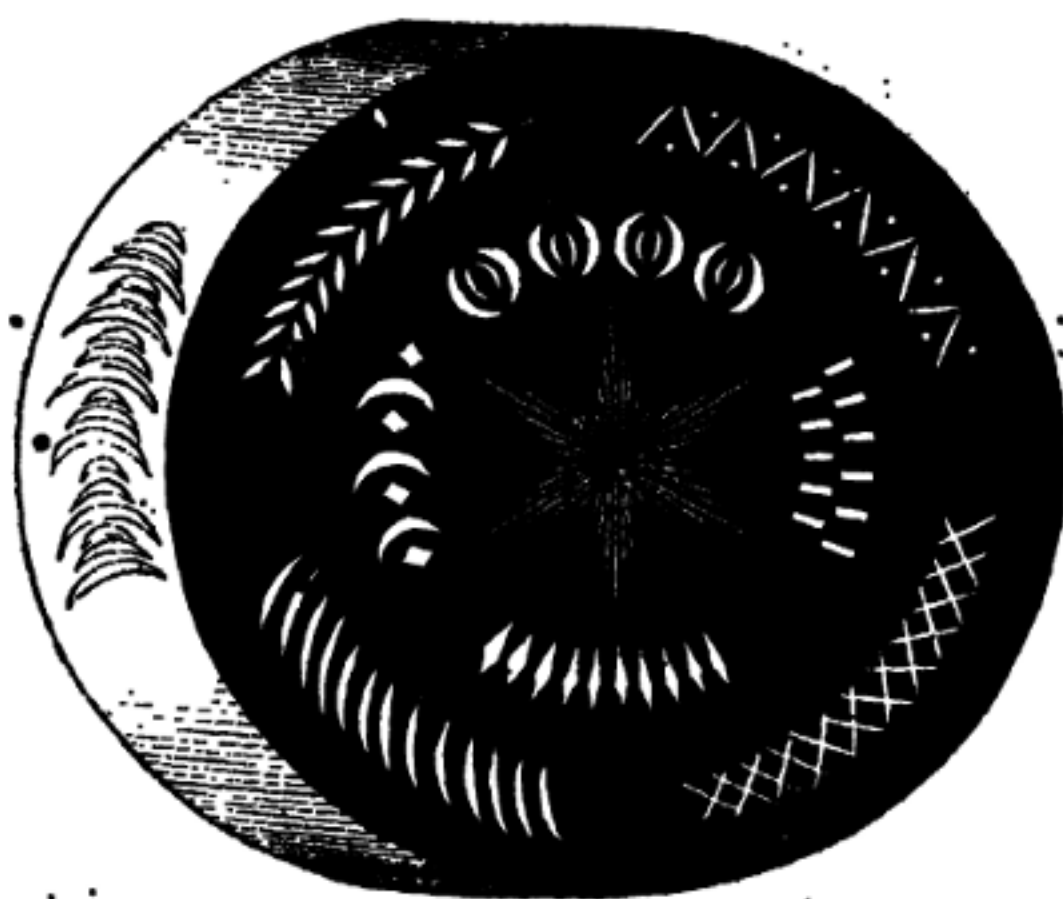
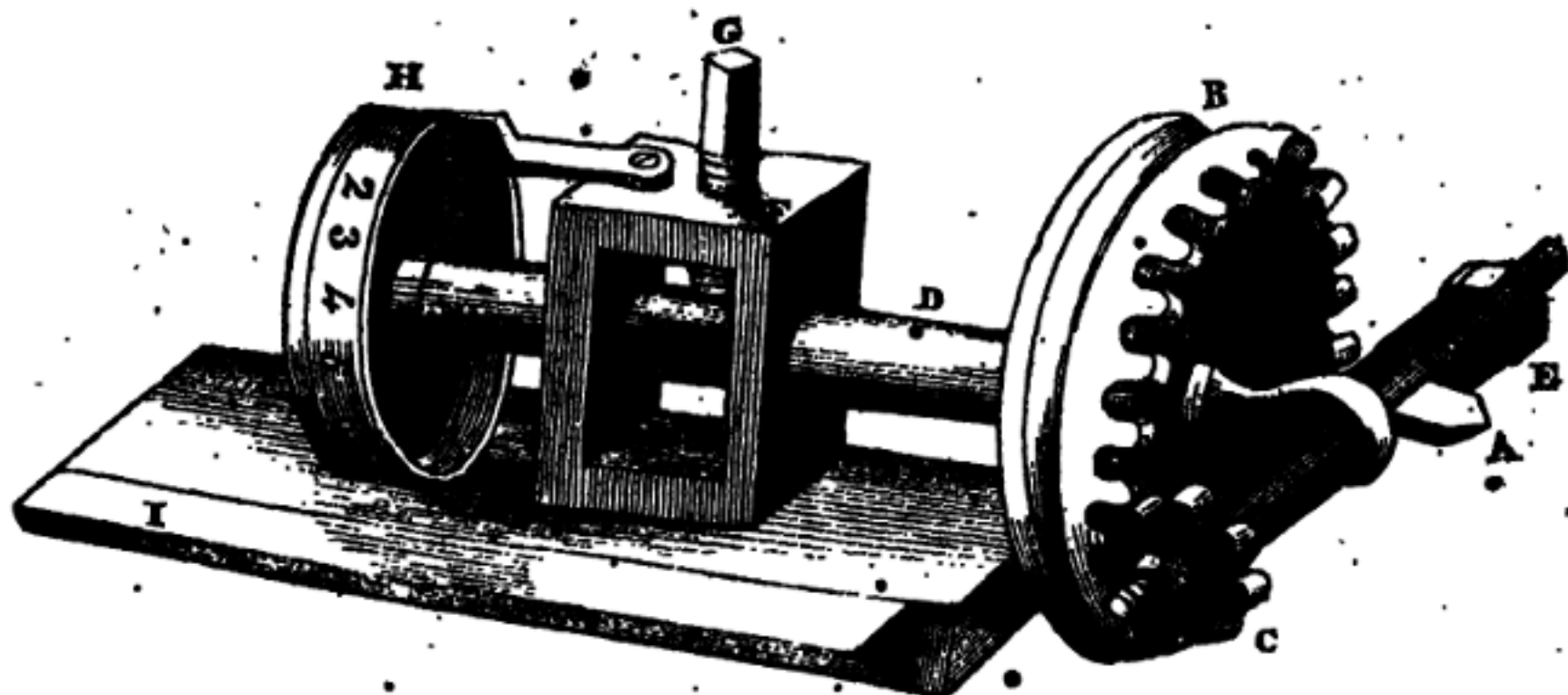
A SPECIMEN of fused charcoal, or supposed artificial diamond, has lately been examined. It was obtained by Professor Macnevin, of New York, by means of Dr. Hare's deflagrator, and was sent to Mr. Vanaxem, for examination, that gentleman having always been very sceptical on the subject. It consisted of a large and small globule connected together by a thread, color black, without lustre, and opaque. When struck, it yielded without breaking, receiving a polish like that of iron; when filed it gave way as iron, or soft steel would do; it was attracted by the magnet, and malleable under the hammer. Nitric acid when heated, acted violently upon it, and ultimately peroxide of iron and a little silica were obtained. The proportion of iron to metallic iron 11.5. Drs. Silliman and Hare, however, deny that Mr. Vanaxem has operated on a proper specimen.

TINCTORIAL MATTER.

ONE of the most curious and valuable facts relative to dyeing by madder is recorded in a memorial of M. Schlumberger, read before the Société Industrielle de Mulhausen. It is, that madder kept in casks, in a warm place, undergoes a species of fermentation, which, by ripening or rather deoxydizing the coloring matter increases its dyeing power by no less than from 30 to 50 per cent.

QUERY.

10. *What vegetable contains the greatest quantity of alcohol?*—No vegetable contains alcohol at all; for alcohol is the result of a peculiar kind of fermentation, in which sugar and gluten are both present, particularly the former; those vegetables which contain the largest proportion of sugar, as sugar cane, beet-root, parsnip, the juice of certain trees, &c. are therefore used with most economy in the production of spirit, although spirit does not exist ready made in any of them.



THE UNIVERSAL, OR VERTICAL CUTTER.

THE UNIVERSAL, OR VERTICAL CUTTER.

(To the Editor.)

SIR.—As you have done me the honor to insert some communications of mine in your valuable Magazine, I send you the drawing of a very useful cutter for ornamenting pieces of turning; the principle of which is doubtless known to some of your readers, but may not be generally so, and therefore may be acceptable to many of them.

It may be termed a vertical, diagonal, or horizontal cutter, the motion being given by a large pulley, with cogs working on a smaller cog wheel which is fixed on a spindle, through which a mortice being cut, and a cutter of any shape being inserted in it, it receives a very rapid motion.

The principal spindle after passing through the large pulley is bent at a right angle from the tool to the small wheel, and is bored through to receive the spindle which carries the cutter; and as this spindle by means of the screw in the standard can be set at any angle, ornamental cuts may be given in any inclination that may be wished. A trifling specimen is given of some of the ways in which it may be used, but many others will naturally suggest themselves in practice. JAMES WILCOX.

A the cutting tool, a mortice being cut through the spindle to hold it. B the pulley which is set in motion by the overtop work, and communicating its motion to C. C giving a rapid motion to the cutter. D the spindle which B runs upon.

E a nut which forces K a collar forward against the tool A, thereby keeping it firm.

F a standard through which the spindle D passes.

G a screw which secures the spindle D in any place or angle it may be set.

H an index marking the position of the cutter. This graduated scale at O being vertical, and it being numbered to the right and left at equal distances, enables an equal angular direction to be given to it either way.

The whole being fixed by the standard F into the slide I, which fits into the slide rest.

K the collar to fix the tool.

The figures refer to as many tools belonging to the universal cutter, and are drawn of the usual size.

DETERMINING THE LONGITUDE.

To find the longitude at sea is a problem which has long engaged the attention of mathematicians; and they have been stimulated in their efforts by munificent rewards which have been offered by some of the maritime states of Europe. The British parliament offered £20,000 for the discovery of a practical method which could be relied on within certain specified limits; and the reward was paid to Mr. Harrison for the improvements which he made in chronometers; one which he sent from England to Jamaica being found less than two minutes in error on its return.

Since the days of Harrison chronometers have been greatly improved; they are made of a more portable size, and are sold at a comparatively cheap rate. They form an essential part of the outfit of every respectable navigator, and have conferred great benefits on maritime science. Formerly the mariner had no guide to his longitude but the dubious one depending on the compass and the log; and at the conclusion of a long voyage errors amounting to several degrees were not unfrequently found in the reckoning. To determine the longitude by celestial

observations, it is necessary to find by independent processes the time at the place where you are; and also at the same instant the corresponding time at some assigned or known meridian, as that of the Royal Observatory at Greenwich, which is the meridian from which English seamen compute their longitude. Now, with respect to the time at the place of observation, we may observe, that for every individual instant, every celestial object has a specific place in the heavens—changing its place as the time changes. At every instant its altitude, or its distance from the horizon, varies; the change of altitude being most rapid when the bearing of the object is east or west, and slowest when the bearing is north or south, that is, when the object is on the meridian.

If then the altitude of a celestial object be observed with a sextant or other like instrument, when the altitude is varying quickly, the true mean time at the place of observation may be found at the instant of taking the altitude. And if, when such an altitude is observed, the time by a chronometer be noted, whose error for Greenwich mean time on a given day, and daily gain or loss, are known, the true mean time at Greenwich may readily be inferred, and the difference between these local times (one for the meridian of the ship, and the other for that of Greenwich) is the longitude of the ship in time; and it may be converted into degrees by allowing 15° for every hour of time. This method of finding the local time at sea, which is that depending on observed altitudes in a known latitude, may be considered as the only one generally practicable at sea; on land many other methods may be used with advantage. We have adverted to one method of finding the Greenwich time, viz. that by chronometers whose errors and rates are settled before going to sea. We have now to give an account of another method of determining this important element, which within the last eighty years has been brought to a high degree of perfection—we mean that by lunar observations. By the successive efforts of men of science, building on the foundation laid by Newton, it is now found practicable to predict the moon's place in the heavens to a very minute degree of accuracy; and in fact, in the Nautical Almanac, her distance from the sun, nine fixed stars, and the four brightest planets, are given for every third hour of mean Greenwich time throughout the year, except when the moon is too near the sun to be visible. It must not however be understood that her distance is given from all of these objects for every day; a few conveniently situated on each side of her are selected for each day, and they are changed for others as the moon changes her place.

Now if with a sextant we observe the distance of the moon from one of the objects whose distances from her on the day of observation are given in the Nautical Almanac, we must first find by computation what the observed distance would have been if the observer had been at the centre of the earth. The methods which have been devised for making this computation are numberless, and many are of nearly equal merit. But for the details of the methods we must refer to works on practical navigation. Having found the distance of the moon from the sun, star, or planet, as seen from the centre of the earth, we have only to turn to the Nautical Almanac for the given day, and find to what Greenwich mean time the distance corresponds; and comparing that time with the local mean time at the ship, the longitude is deduced as before.

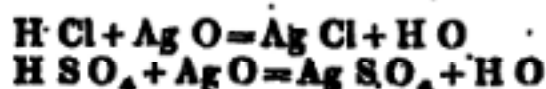
In deducing the distance seen at the centre from that observed on the surface of the earth, the altitudes of both objects are necessary elements; and if either of the objects be at a suitable distance from the meridian, the mean time at the place may be deduced from its altitude, and the longitude found accordingly. The longitude may also be found, by comparing the mean time at the ship, of the immersion of one of Jupiter's satellites in his shadow, or the emersion of the satellite from the shadow, with the Greenwich time of the immersion or emersion as given for the day in the Nautical Almanac. Much difficulty has however been experienced in holding a telescope, of sufficient magnifying power for observing these eclipses, steady at sea; but we are assured that some persons have succeeded in doing so. Eclipses of the moon have also been used for finding the Greenwich time; but the times of beginning and end, or the contact of the border of the earth's shadow with spots on the moon, can seldom be noted with requisite precision. Eclipses of the sun, and the kindred phenomena of occultations of stars by the moon have occasionally been made available for the same object. They admit of great precision in the results, but the necessary calculations are long and intricate, and the phenomena occur too seldom to be of much use in the practice of navigation. It is to the moon, however, that astronomers have in general looked for the solution of this problem; the comparative quickness of her angular motion rendering her decidedly the most eligible of all celestial objects for determining by her motions small intervals of time.

THE BINARY THEORY OF SALTS.

(Resumed from page 300.)

A SALT is formed when either of the acids is neutralized by combining with ammonia, a metallic oxide, or an organic base. Now when a salt is thus formed, one phenomenon constantly occurs, and this is the reparation of water. In the simplest case, viz. when the hydracid of an elementary body acts on a metallic protoxide; the origin of the water is quite obvious. When hydrochloric acid, for example, acts on oxide of silver, chloride of silver is formed, and water is eliminated.

There is here no doubt that the water is produced by the action. But when hydrated sulphuric acid acts on the same oxide, although the phenomena are exactly the same, a different explanation is commonly given, viz. the water is assumed to have pre-existed in the acid. Now it is contrary to all sound principles of reasoning to adopt two explanations of facts precisely similar, where one will suffice, and only one explanation of the former case being possible, we must apply the same explanation to the latter. This is done by the new theory, and the following will show the identity of the re-action in the two cases—



In both cases the water is formed by the union of the hydrogen of the acids with the oxygen of the oxide, and consequently, in both cases, the hydrogen of the acid has been replaced by the metal. Again, let hydrochloric acid and the metal zinc be taken: here the hydrogen of the acid, being replaced by the metal, is expelled, and finding no oxygen with which to combine makes its appearance in the gaseous state. But when the same metal is thrown into sulphuric acid, (being the usual process for pro-

ducing hydrogen gas,) upon the old view of the constitution of salts, a complicated play of affinities was supposed to take place; the zinc, (by the aid of some unknown force, denominated the disposing affinity of the sulphuric acid,) decomposing the water, which alone it was incapable of doing, and thus forming an oxide, which then united with the sulphuric acid, while the hydrogen was evolved. This explanation, involving the fact that zinc at one time would, and at another, would not, decompose water, was always felt to be but a lame one; the solubility of the oxide in the acid, to which its influence was generally ascribed, accounting for the continuance of the action by providing for the removal of the oxide, rather than for its commencement. How much more simply and philosophically are the phenomena explained, by considering this also as a case of mere replacement of the hydrogen, in sulphatoxide of hydrogen, by a metal zinc, and an evolution of the gas, as in the former instance.

It is evident that the view we have taken of sulphuric acid is also applicable to hydrated oxygen acids in general, which may be made hydrogen acids by assuming the existence of a new radical for each, containing an atom more of oxygen than the oxygen acid itself, and capable of combining directly with hydrogen and the metal. Thus hydrated nitric acid or aqua-fortis becomes a hydrogen acid by the creation of a nitrate radical, nitratooxygen. It is the nitratooxide of hydrogen, instead of the nitrate of water.



The nitrate of potassa becomes the nitratooxide of potassium, and so of the other metals; and with other radicals of other salts. The class of oxygen acid salts is thus abolished, and they become binary compounds, like the chlorides and cyanides. Even oxygen acids themselves can no longer be recognized. It is not sulphuric acid, (S O_3), but what was formerly viewed as its compound with water that is the acid, and it is a hydrogen acid.

Here then is the theory of salts; a salt is formed when the hydrogen of the acid is replaced by an equivalent of a metal. Consequently acids may be viewed as the hydrogen salts of their radicals, and thus acids and salts, in regard to their constitution, form but one great class. This view has therefore the great advantage of bringing under one head the three divisions of oxyacid, hydracid, and haloid salts, which was formerly impossible, as the two latter orders being only binary did not rank compatibly with the double binary compounds, and as already stated the acids being viewed upon this system as the hydrogen salts of their radicals, the further great desideratum of the abolition of all distinction whatever between acids and salts, and the bringing them all into one grand classification is satisfactorily accomplished.

On this view it is obvious that the acids and the salt are really bodies of the same constitution, hydrochloric acid being the chloride of hydrogen, as common salt is the chloride of sodium, and sulphuric acid and sulphate of soda being the sulphatooxides of hydrogen and sodium. The acid reaction and sour taste are not peculiar to the hydrogen compound, and do not separate it from the others, the chloride, sulphatooxide, and nitratooxide of copper, being nearly as acid and corrosive as the chloride, sulphatooxide, and nitratooxide of hydrogen, and clearly bodies of the same character and composition. They are all equally salts in constitution. The theory in question is therefore truly a theory of salts, and is conse-

quently distinguished as the theory of binary salts, or some such name, with more propriety than the theory of hydrogen acids.

It is sometimes made a matter of objection to this theory, that it involves the necessity of supposing a great number of imaginary bodies, the salt radicals, one for each of the oxygen acids; such supposition, it is said, being contrary to true science, and quite uncalled for. The fallacy of this reasoning will, however, be apparent, when we consider how many imaginary radicals are already undisputedly allowed to exist, and also that most of the so-called anhydrous acids are likewise purely imaginary; and therefore we are only, in adopting this theory, substituting an imaginary radical for an imaginary acid. We need only refer to nitric, oxalic, chloric, acetic, and all the other organic acids, for support on this point. Not one of these acids has ever been obtained free from water, and their composition, when supposed anhydrous, is only matter of calculation, derived from the analysis of their salts. This theory also accounts, as we have before shown, for the separation of water on the addition of a basic oxide, for which no good cause could previously be given. In the few cases, in which bodies supposed to be anhydrous acids have been observed, their properties fully confirm the notion, that not they, but their hydrates, are the true acids. The fibrous white substance, (SO_3) called anhydrous sulphuric acid, is totally destitute of all the characteristics of that body. It has no corrosive properties, does not redden litmus, will not combine with bases; but, on the contrary, has a tendency to unite with chloride of potassium, sulphate of potassa, and other previously-existing salts; and it forms, with ammoniacal gas, a compound which is certainly not sulphate of that base. Again, liquid carbonic acid is a rather inactive agent, has little affinity for water, does not combine directly with lime, but dissolves in alcohol, ether, and essential oils, like certain neutral bodies. Surely these facts tend to demonstrate that not they, and corresponding substances, but the same elements, with the addition of the elements of one atom of water, are the true acids.

(To be continued.)

COLORED DAGUERREOTYPES.

(A Patent taken out recently by Mr. Beurd.)

THIS invention consists in various modes of coloring the pictures produced by the Daguerreotype process. By the first method the object is obtained by reduping the colors to an impalpable powder, and depositing them upon different parts of the picture in succession; the extent of each color being determined by a pattern or screen, resembling a stencil plate.

The mode of operation is as follows:—The Daguerreotype picture is first placed in a rectangular frame, which is formed with a projecting edge, of about $\frac{1}{16}$ of an inch in thickness. Over this frame a piece of glass or mica is laid, and a tracing is made upon it with coloring matter, of the shape of those parts of the picture that are to be colored. From this tracing a number of patterns or screens are formed, one for each color. Each screen consists of a light rectangular frame, covered with tracing paper, upon which all those parts that are required to be of one color are traced, and the space included between the traced lines is cut out; so that when the screen is placed upon the picture, the tracing paper will cover its surface, except those parts which are required to be of a uniform tint.

The colors are prepared by grinding them to an impalpable powder, with a weak solution of gum-arabic, isinglass, starch, or other similar material; they are then dried in a stove, (kept at a heat somewhat less than 212° Fahr.) and, after being passed through a fine sieve, are ready for use.

In applying these colors, a number of boxes, of a size sufficient to admit the picture, are employed, and into each box, the number of which varies according to the tints required, a few grains (say about fifty) of color are deposited. The color is agitated with a large soft brush, until a dust is created in the box, and the picture, covered by one of the screens, being then introduced, the particles of color settle upon the screen, and upon those parts of the picture that are not covered by it. After this operation the picture is withdrawn, the screen taken off, and the color removed from the shaded parts by means of a small pair of bellows; the remainder of the color is then attached to the picture by breathing upon it, which partially dissolves the gum, and the process is completed.

The second improvement consists in mixing the colors with gum-water, and applying them with a hair pencil, to the underside of the glass that covers the picture; so that when the latter is seen through the glass, it will present the appearance of a colored picture.

The third and last method consists in using the colors in a dry pulverized state, as in the first improvement, dotting them on to the picture, with small brushes in a similar manner to stippling; the colors are then fixed by being breathed upon.

[We cannot see any thing at all in the above, which is likely to be successful, for it is nothing more nor less than oriental tinting and certainly can confer no exclusive patent right.—ED.]

ON A GASEOUS VOLTAIC BATTERY.

BY MR. GROVE.

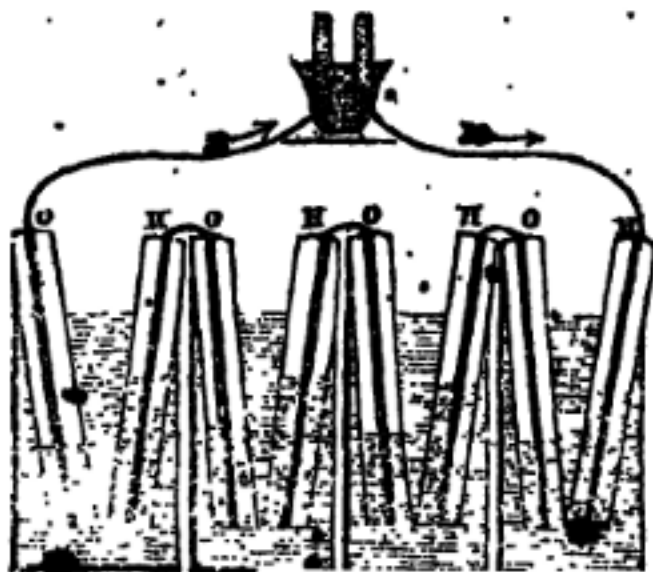
(From the Philosophical Magazine.)

IN the "Philosophical Magazine," for February, 1839, I have given an account of an experiment in which a galvanometer was permanently deflected when connected with two strips of platina, covered by tube containing oxygen and hydrogen. At the conclusion of my notice, I say, "I hope, by repeating this experiment in series, to effect decomposition of water by means of its composition." The next paper of mine, published in the same year, contains an account of a battery to which the public are since attached my name, and which led me into a different field of research.

In reading over my papers lately for a purpose alluded to in my letter of last month, I was struck with the above sentence. My impression was, that I had expressed a hope not very likely to be realized; but after a few days consideration I saw my way more clearly, and determined to try the experiment.

As the chemical or catalytic action in the experiment detailed in that paper could only be supposed to take place with ordinary platina foil, at the line or water-mark where the liquid gas and platina met, the chief difficulty was to obtain anything like a notable surface of action. To effect this, my first thought was to surround the platina foil with spongy platina, precipitated in the usual way by muriate of ammonia. This was suggested to me by the known action of spongy platina on mixed gas; which would by its capillary attraction expose a considerable surface of metal and liquid to the action of the gases.

I still think this would be the best mode of effecting the object; but as it was very troublesome in manipulation, I determined to try the platinum platinized by voltaic deposition from the chloride, as proposed for a different purpose by Mr. Smee. I therefore caused a series of fifty pairs to be constructed, the form and arrangement of which is given in the annexed figure, where O denotes tubes filled with oxygen; H others filled with hydrogen, and the dark



line in the axis of the tubes platinized platinum foil, which in the battery I constructed was about one-fourth of an inch wide. It is obvious that, by allowing the platinum to touch the liquid, the latter would spread over its surface by capillary action, and expose an extended superficies to the gaseous atmosphere. The battery was charged with dilute sulphuric acid, sp. gr. 1.2, and the following effects were produced:—

1st. A shock was given which could be felt by five persons joining hands, and which when taken by a single person was painful.

2nd. The needle of a galvanometer was whirled round, and stood at about 60° ; with one person interposed in the circuit it stood at 40° , and was slightly deflected when two were interposed.

3rd. A brilliant spark visible in broad day-light was given between charcoal points.

4th. Iodide of potassium, hydrochloric acid, and water acidulated with sulphuric acid were severally decomposed; the gas from the decomposed water was eliminated in sufficient quantity to be collected and detonated. The gases were evolved in the direction denoted in the figures; i. e. as the chemical theory and experience would indicate, the hydrogen travelling in one direction throughout the circuit, and the oxygen in the reverse. It was found that 26 pairs were the smallest number which would decompose water, but that four pairs would decompose iodide of potassium.

5th. A gold leaf electroscope was notably affected.

6th. The battery was charged with distilled water; the electroscope was affected, and iodide of potassium decomposed.

7th. Although the phenomena were too marked to render it in the least probable, that accidental circumstances could have produced the current, still counter experiments were carefully gone through; thus the gases were repeatedly changed, oxygen being placed in the tubes which had contained hydrogen, and vice versa. The effects were equally powerful, and the direction of the current was reversed.

8th. All the tubes were charged with atmospheric air; no effect was produced.

9th. The battery was charged with carbonic acid and nitrogen in the alternate tubes; not the slightest effect observable.

10th. It was charged with oxygen and nitrogen; not any effect.

11th. With hydrogen and nitrogen, slight effects. The difference between this and the last experiment at first struck me as extraordinary, but upon consideration was easily explicable. The liquid being exposed to the air would necessarily absorb some oxygen, and this with hydrogen would give rise to a current. This was proved by the liquid rising in the hydrogen tubes, but not in those containing nitrogen; and, as a further proof, one set of tubes was charged with hydrogen, and the alternate set with acidulated water without gas; a slight current was perceptible: with oxygen and the liquid in alternate tubes there were no effects produced.

12th. As the oxygen and hydrogen were procured in the first instance by electrolysis, and as Dr. Schœnbein in his careful experiments on polarized electrodes supposed the peculiar substance, which he has named Ozone, to be a principal agent, I caused the tubes to be charged with oxygen evolved from chlorate of potash and oxide of manganese, and hydrogen from zinc and sulphuric acid; the effects were the same.

The tubes were not all of equal size, nor were they graduated; the exact proportional diminution of gas in each tube could not be ascertained with perfect accuracy; both gases did diminish, and the hydrogen so much more rapidly than the oxygen, that my assistant, who was unacquainted with the rationale of the battery, observed that the hydrogen was absorbed twice as fast as the oxygen. Mr. Gasiot is now preparing a graduated battery of this sort, by which the point will be accurately determined; supposing the gases at the electrodes and at the plates exposed to uniform facilities of solution, the quantity evolved should be equal to that absorbed.

Several curious points are suggested by this novel battery.

How is its action explicable on the contact theory? I am by no means wedded to any theory, and have constantly endeavoured to look with the eye of a contact theorist upon the facts of voltaic electricity, but I cannot see them in that light; if there be any truth in the contact theory, I either misunderstand it, or my mind is unconsciously biased. Where is the contact in this experiment, if not everywhere? Is it at the points of junction of the liquid, gas, and platinum? If so it is there that the chemical action takes place; all chemistry may be referred to contact, or upon the theory of an universal plenum, all natural phenomena may be referred to it. Contact may be necessary, but how can it stand in the relation of a cause, or of a force?

Its phenomena present to my mind a resolution of catalysis into voltaic force, in other words, the action of this battery bears the same relation to the phenomena of catalysis as that of the ordinary batteries does to those of ordinary chemistry. Whether these effects could be produced by other inoxidable metals (such as gold or silver) is an experiment worth trying. The more we examine chemical and voltaic actions, the more closely do we assimilate them. For some mysterious reason three elements seem necessary for very many if not for all chemical actions.

This battery is peculiar in having the current generated by gases, and by synthesis of an equal but not at both anode and cathode; it is

therefore, theoretically, more perfect than any other form, as the batteries at present known, act by one affinity at the anode, and have to overcome another at the cathode.

This battery establishes that gases in combining and acquiring a liquid form evolve sufficient force to decompose a similar liquid and cause it to acquire a gaseous form. This is to my mind the most interesting effect of the battery; it exhibits such a beautiful instance of the correlation of natural forces.

Many other notions crowd upon my mind, but I have occupied sufficient space and must leave them for the present, hoping that other experimenters will think the subject worth pursuing.

London Institution, Oct. 29. 1842.

W. R. GROVE.

METHOD OF FIXING CRAYONS.

CRAYON painting is superior to oil painting in brightness, freshness, splendor of coloring, and fidelity of likeness. It is attended with this advantage also, that it is not subject to that reflection of light which prevents the beauty of a painting from being seen except from a certain point of view. On account of these valuable qualities, it would certainly have been preferred to oil painting, had it been equally durable; but it has this inconvenience, that it is liable to be destroyed by the least friction. At the end of a few years, master-pieces of this kind perish, because the powder of the crayons detaches itself, or becomes mouldy, especially if great care be not taken to preserve these paintings from moisture, and from the heat of the sun. The following liquor, however, has been employed with success for fixing crayons: it is not expensive, and nothing is necessary but to immerse the painting in it for a few moments.

To prepare this liquor, dissolve Roman alum pulverized, in two glassfulls of very pure water, and when the water is saturated, decant it from off the alum which may have remained undissolved at the bottom of the vessel. This observation is of great importance; for if the alum which has not been dissolved were left in the liquor, by becoming dry it might tarnish the painting, and produce whitish spots in those places where the liquor accumulates itself in draining off.—Into this water, well impregnated with alum, put a small quantity of very transparent and pure fish-glue, leaving it to dissolve for twenty-four hours, and then boil the whole, that the glue may be dissolved completely. The liquor must afterwards be strained through a piece of linen, to free it from any impurities it may contain.

In the last place, pour the water thus impregnated with alum and glue, into a bottle containing three parts of brandy, not colored, and mixed with a large glassful of spirit of wine. A greater or less quantity of this liquor may be made according to the size of the paintings to be fixed, provided care be taken to increase the ingredients in the proper proportions. It is, however, to be observed, that it must not be used when too old, as in that case it would weaken the splendor of the painting.

Put the liquor, thus prepared, into a vessel of lead, or of any other substance, so large that the painting may be immersed in it and heat it in a balneum marie, taking care that the fish-glue be well dissolved; for before the liquor is heated, especially if the weather be cold, it will deposit itself at the bottom. Place in each corner of the basin a bit of lead, in such a manner that the liquor may rise over it no more than a line at most, and then lay hold of

the painting, keeping it in a horizontal position, and immerse it gently into the liquor. The pieces of lead, placed in the vessel, will prevent it from sinking too deep. The time employed in immersing and taking out the painting, ought not to exceed a second. The painting must be taken out horizontally, and be deposited in the same position, in some place where it can rest on its two borders, which it will do if supported by two chairs.

If the above process be properly followed, it will be found that all the tints have retained their original freshness and primitive color. Crayons fixed in this manner will bear even to be covered with a varnish, which may supply the place of glass. To lay on this varnish, the following method may be employed:

When the painting is fixed and dry, apply over it, with a soft brush, a stratum or two of melted fish-glue, mixed with about a third of spirit of wine, and sufficiently strong that when cold it may form a sort of jelly. When this preparation is dry, apply that varnish used for varnishing prints, which will produce the same effect as on paintings in distemper.

Crayon paintings, fixed in the above manner, are attended with this advantage, that they may be retouched; for the crayons will make an impression as before; some strengthening touches may even be added with color in distemper. This method employed for crayons may be used also for fixing chalk drawings.

PIN MANUFACTURE.

A PIN is a small bit of wire, commonly brass, with a point at one end, and a spherical head at the other. In making this little article, there are no less than fourteen distinct operations.

Straightening the wire.—The wire, as obtained from the drawing-frame, is wound about a bobbin or barrel, about 6 inches in diameter, which gives it a curvature that must be removed. The straightening engine is formed by fixing 6 or 7 nails upright in a $\vee$ aving line on a board, so that the void space measured in a straight line between the first three nails may have exactly the thickness of the wire to be trimmed; and that the other nails may make the wire take a certain curve line, which must vary with its thickness. The workman pulls the wire with pincers through among these nails, to the length of about 30 feet, at a running draught; and after he cuts that off, he returns for as much more as he can thus finish 600 fathoms in the hour. He next cuts these long pieces into lengths of 3 or 4 pins. A day's work of one man amounts to 18,000 or 20,000 dozen of pin-lengths.

2. *Pointing* is executed on two iron or steel grindstones, by two workmen, one of whom roughens down, and the other finishes. Thirty or forty of the pin-wires are applied to the grindstone at once, arranged in one plane, between the two forefingers and thumbs of both hands, which dexterously give them a rotatory movement.

3. *Cutting these wires into pin-lengths.*—This is done by an adjusted chisel. The intermediate portions are handed over to the pointer.

4. *Twisting of the wire for the pin-heads.*—These are made of a much finer wire, coiled into a compact spiral round a wire of the size of the pins, by means of a small lathe constructed for the purpose.

5. *Cutting the heads.*—Two turns are dexterously cut off for each head, by a regulated chisel. A skillful workman may turn off 12,000 in the hour.

5. *Annealing the heads.*—They are put into an iron ladle, made red hot over an open fire, and then thrown into cold water.

7. *Stamping or shaping the heads.*—This is done by the blow of a small ram, raised by means of a pedal lever and cord. The pin-heads are also fixed on by the same operative, who makes about 1500 pins in the hour, or from 12,000 to 15,000 per diem; exclusive of $\frac{1}{8}$, which is always deducted for waste in this department, as well as in the rest of the manufacture. Cast heads, of an alloy of tin and antimony, were introduced by patent, but never came into general use.

8. *Yellowing or cleaning the pins,* is effected by boiling them for half an hour in sour beer, winelees, or solution of tartar; after which they are washed.

9. *Whitening or tinning.* A stratum of about six pounds of pins is laid in a copper pan, then a stratum of about seven or eight pounds of grain tin; and so alternately till the vessel be filled; a pipe being left inserted at one side, to permit the introduction of water slowly at the bottom, without deranging the contents. When the pipe is withdrawn, its space is filled up with grain tin. The vessel being now set on the fire, and the water becoming hot, its surface is sprinkled with four ounces of cream of tartar; after which it is allowed to boil for an hour. The pins and tin grains are lastly separated by a kind of cullender.

10. *Washing the pins* in pure water.

11. *Drying and polishing them* in a leather sack filled with coarse bran, which is agitated to and fro by two men,

12. *Winnowing* by fanners.

13. *Pricking the papers* for receiving the pins.

14. *Papering* or fixing them in the paper. This is done by children, who acquire the habit of putting up 36,000 per day.

The pin manufacture is one of the greatest prodigies of the division of labor; it furnishes 12,000 articles for the sum of three shillings, which have required the united diligence of fourteen skilful operatives. The above is an outline of the mode of manufacturing pins by hand labor, but several beautiful inventions have been employed to make them entirely or in a great measure by machinery; the consumption for home sale and export amounting to 15 millions daily for this country alone. One of the most elaborate and apparently complete, is that for which Mr. L. W. Wright obtained a patent in May, 1824. A detailed description of it will be found in the 9th volume of Newton's "London Journal." The following outline will give my readers an idea of the structure of this ingenious machine:—

The rotation of a principal shaft mounted with several cams, gives motion to various sliders, levers, and wheels, which work the different parts. A slider pushes pinners forwards, which draw wire from a reel, at every rotation of the shaft; and advance such a length of wire as will produce one pin. A dye cuts off the said length of wire by the descent of its upper chap; the chap then opens a carrier, which takes the pin to the pointing apparatus. Here it is received by a holder, which turns round while a bevel-edged file-wheel rapidly revolves, and tapers the end of the wire to a point. The pin is now conducted by a second carrier to a finer file-wheel, in order to finish the point by a second grinding. A third carrier then transfers the pin to the first heading die, and by the advance of a steel punch, the end of the pin wire is forced into a recess, whereby the head is partially swelled out. A fourth carrier re-

moves the pin to a second die, where the heading is perfected. When the heading-bar retires, a forked lever draws the finished pin from the die, and drops it into a receptacle below.

I believe the chief objection to the raising of the heads by strong mechanical compression upon the pins, is the necessity of softening the wire previously; whereby the pins thus made, however beautiful to the eye, are deficient in that stiffness which is so essential to their employment in many operations of the toilet.

CLIMATE OF BRITAIN.

THE climate of the British Isles, relatively to others in the same latitude, is temperate, humid, and variable. The moderation of its temperature and its humidity are owing to our being surrounded by water, which being less affected by the sun than the earth, imbibes less heat in summer, and, from its fluidity, is less easily cooled in winter. As the sea on our coast never freezes, its temperature must always be above 33° or 34°; and hence, when air from the polar regions at a much lower temperature passes over it, that air must be in some degree heated by the radiation from the water. On the other hand, in summer, the warm currents of air from the south necessarily give out part of their heat in passing over a surface so much lower in temperature. The variable nature of our climate is chiefly owing to the unequal breadths of watery surface which surround us; on one side a channel of a few leagues in breadth; on the other, the Atlantic Ocean. The temperature of the British seas rarely descends below 35° or 54°.

The British climate varies materially within itself; some districts are dry, as the east; others moist, as the west coast; in the northern extremity, dry, cold, and windy; in the south, warm and moist. Even in moist districts some spots are excessively dry, as part of Wigtonshire, from the influence of the Isle of Man in warding off the watery clouds of the Atlantic; and in the dry districts, some parts are moist, from the influence of high mountains in attracting and condensing clouds charged with watery vapor. The mean temperature of London equals 50° 36'; that of Edinburgh equals 47° 84'; and the probable mean temperature of all Britain will equal 48°. The usual range of the barometer is within three inches. The mean annual rain is probably about 32 inches. The climate is variable, and subject to sudden alternations of heat and cold, which are supposed to render pulmonary complaints common with us: but on the whole it is healthy, and the moisture of our clouded atmosphere clothes our fields with a lasting verdure unknown to the more favored regions of Southern Europe.

The deterioration of the British climate is an idea entertained by some; but whether in regard to general regularity, temperature, moisture, or wind, the alleged changes are unsupported by satisfactory proofs. It is not improbable but the humidity of our climate, as Williams alleges (*Climate of Britain*, &c., 1816), has of late years been increased by the increase of evaporating surface, produced by the multiplicity of hedges and plantations; a surface covered with leaves being found to evaporate considerably more than a naked surface. If the humidity of the climate were greater before the drainage of morasses and the eradication of forests for agricultural purposes, a comparative return to the same state, by artificial planting and irrigation, must

have a tendency to produce the same results. However, it will be long, before the irrigation of lands is carried to such a degree as to produce the insalubrious effects of undrained morasses; and as to our woods and hedges, we must console ourselves with the beauty and the shelter which they produce for the increase of vapor supposed to proceed from them.

M. MAUGE'S METHOD OF STUFFING BIRDS.

THIS naturalist had a method of preparation and stuffing, of which he was the inventor, and which he practised with considerable success. It was as follows:—(The bird is supposed to be a small one.)

He took two pieces of wire, in length and thickness required for the bird he was about to stuff. One of these was somewhat longer than the other. The longer piece he pointed at both ends with a file, and the shortest piece at one end only. One end of each wire was held under the fore finger and thumb of the left hand; he then twisted the other parts five or six times round, about three quarters of an inch from the point of the other wire with the finger and thumb of the right hand, leaving an untwisted space large enough for a finger to pass through; he now twisted it four or five times more, leaving a second space untwisted for the purpose of passing the feet-wire through, and also of producing a triangular form with the first interval he had left untwisted, the smaller opening being one turn above the triangle.

The wires for the feet were straight, and pointed at one end in the ordinary form. When the head and neck were stuffed, he introduced the long end of the centre wire through the neck and skull, and the other extremity which was forked, and passed it across the rump to support the tail feathers. He then forced up one of the leg-wires, and brought the end of it through the small hole which was situated above the triangle, and then gave it an inclination towards the opposite parts, and united the two with threads; the same method was then adopted with the other leg.

LUTING FOR BOTTLES.

COMMON resin, red ochre reduced into a fine powder, yellow wax, and oil of turpentine. These must be melted over a fire in the following manner; and the vessel in which it is made, should be capable of holding three times the quantity required, to allow ample room for boiling up. An earthenware pipkin with a handle is the best thing for the purpose, and a lid must be made of tin to fit it. The luting will be rendered more or less brittle, or elastic, as the red ochre prevails. The wax is first melted, and then the resin; the ochre is then added in small quantities, and stirred quickly with a spatula each time. When all the ochre has been added, it must be allowed to boil six or eight minutes; the turpentine is then added, and briskly stirred with the spatula, and continue to boil it. There is considerable risk of the mixture taking fire, and should it do so, the lid must immediately be put on the vessel to extinguish it.

VELVET PAINTING

(To the Editor.)

SIR,—In answer to your query, I forward a few instructions upon painting on velvet, which I

hope may prove both amusing and instructive, as velvet will produce splendid illustrations of fruit, flowers, and many kind of animals, that cannot be produced with any other ground. Procure first the colors in powder, and grind them in spirits, of which good clear gin is as good as anything. When fine or mixed smooth, they may be kept in small wide-necked bottles until wanted for use, as they cannot be mixed with advantage every time when they are used; they will not be so smooth. Then procure some stiff hogs-hair brushes called scrubs, and have ready some gum adragant, or what some call gum dragon, which is a sily kind of gum, which must be previously melted in water, and strained through a muslin to prevent the lumps that it is full of.

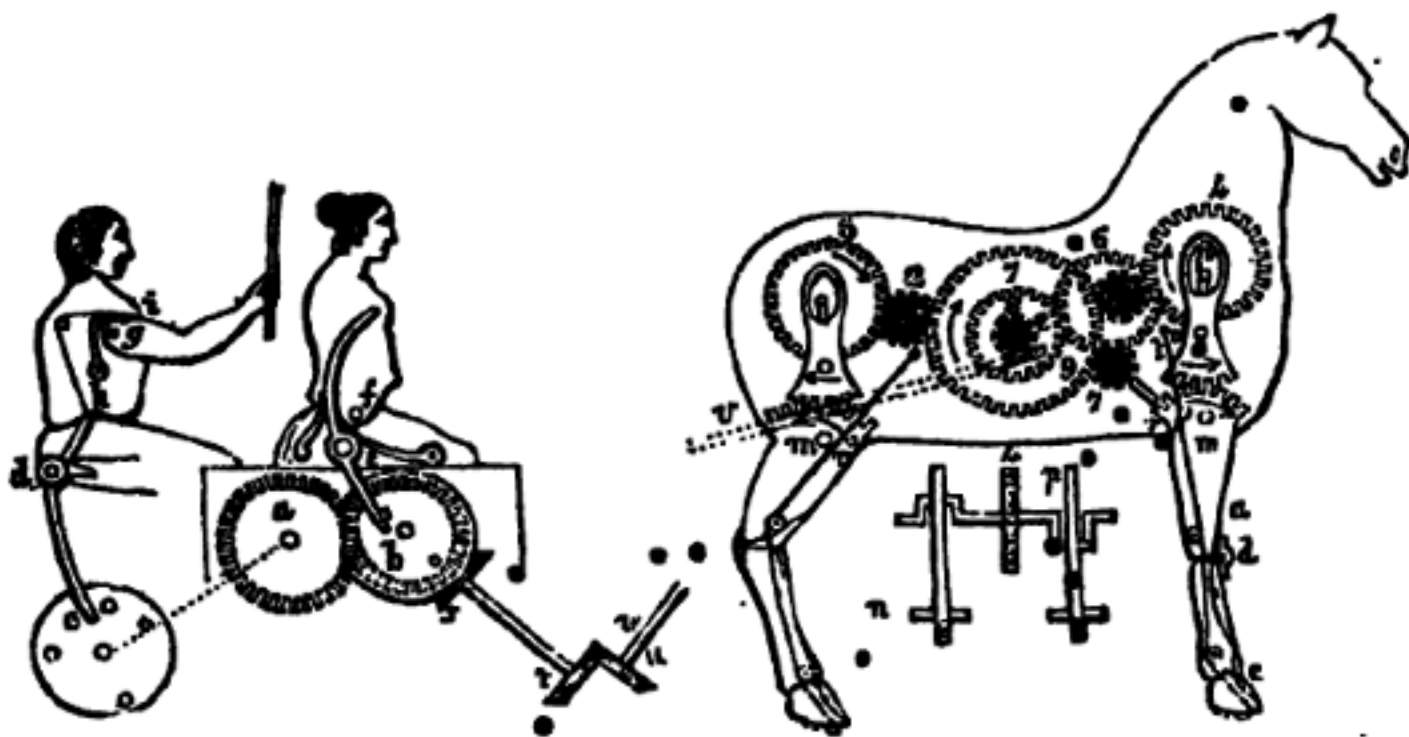
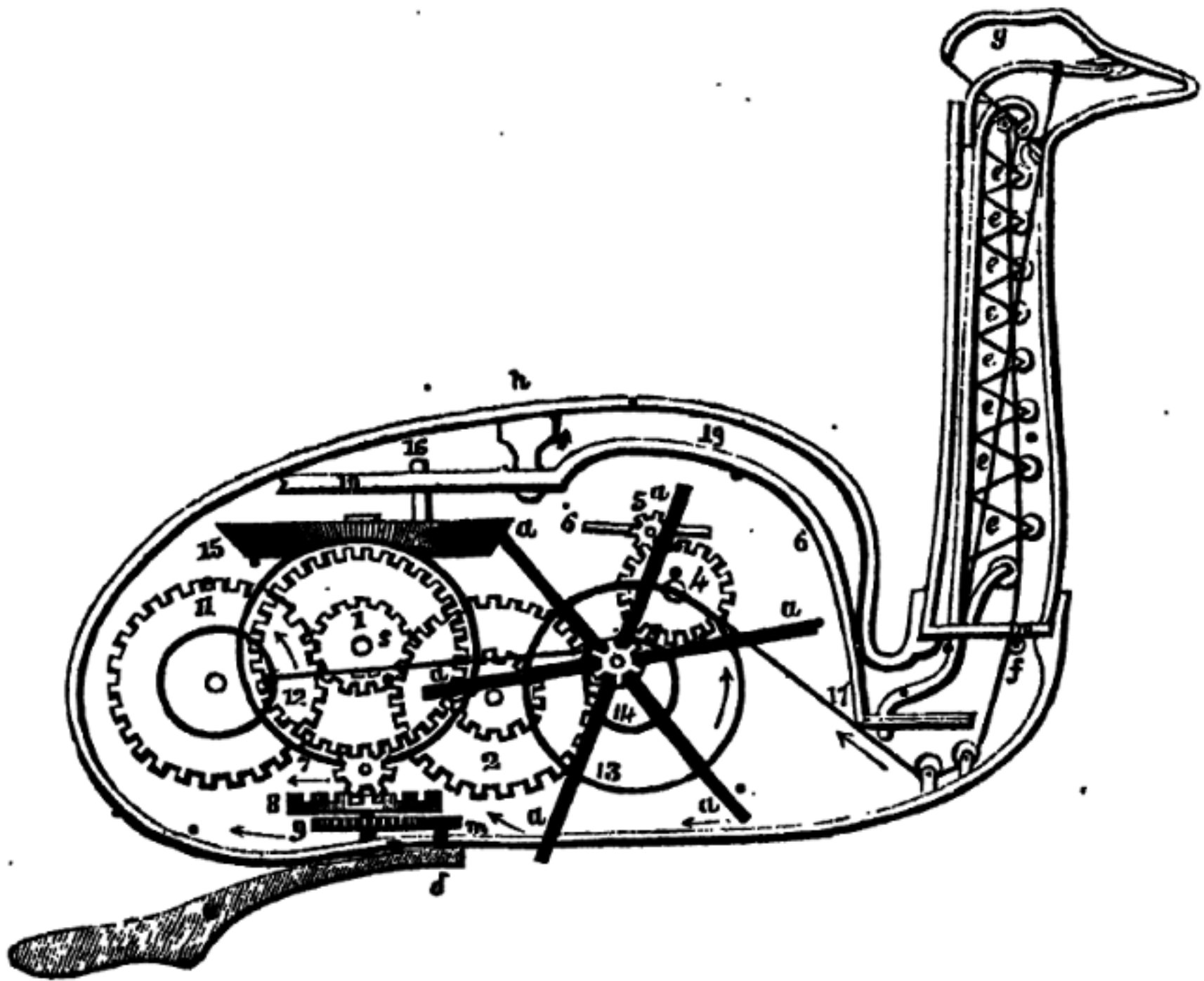
You may now commence painting according to the rules of either water or oil painting, and if done by an artist, splendid specimens may be produced of fruit, flowers, animals, or ornamental arabesque designs, or for the last, they may be cut out in scrolls, garlands, &c. By pinning or tacking the velvet upon a board with the pile or face downwards, then rubbing common bookbinders' paste made of flour and water over the back, and when dry, it may be taken off the board, or what is better, to draw your design upon it first, before removing it either by drawing or by pouncing upon a paper already pierced with holes, the design you intend to make, afterwards removing it, and cutting it out with scissors, then lay the face uppermost, and finish it by painting as aforesaid.

I have also before me an account of a process, which was the subject of a patent in France, and which was applied by means of stencilling, of which you have already given an account, and it says:—

“The execution of this process requires a great deal of care and attention in order to avoid obliteration, the design for the whole is performed continually, without waiting for the part which is just painted to be dry, before commencing another. At last the parts that have not taken well are corrected and finished with a pencil, or by means of new pieces of parchment.

“Preparation of the oil used in this kind of painting:—I grind into very fine powder, 20 grains of sal ammoniac, and 20 grains of prunella; I throw this powder into 1 lb. of the clearest linseed oil that can be obtained, and boil it for three hours. One hour before taking the oil off the fire, I put into it a piece of soft bread, which I have carefully soaked in oil of vitriol, and three large onions cut in pieces. When the bread is almost calcined, and the onions are dissolved, I take off the oil, and strain it through a new piece of coarse cloth; I put it afterwards in bottles, and use it for grinding the colors, as I require them for painting, observing to employ it with management that the colors shall not run on glass, but have the consistence of butter. This oil does not spread on the velvet beyond the outlines of the drawing;” and neither should the first process; and if I have not stated the process clear enough to your readers, I will endeavour to explain any part of it more fully, upon application by means of a line from you, as I have seen a great deal of it performed.

The printing upon velvet that is prepared for dresses is performed by the same process as calico printing, which is entirely a trade, and not an amusement as is here explained. WILLIAM HUNS.



AUTOMATA AND THEIR CONSTRUCTION.

AUTOMATON.

In the etymological sense, this word (self-working) signifies every mechanical construction which, by virtue of a latent intrinsic force, not obvious to common eyes, can carry on for some time certain movements more or less resembling the results of animal exertion, without the aid of external impulse. In this respect all kinds of clocks and watches, planetariums, common and smoke jacks, with a vast number of the machines now employed in our cotton, silk, flax, and wool factories, as well as in our dyeing and calico printing works, may be denominated automatic. But the term automaton is in common language appropriated to that class of mechanical artifices in which the purposely-concealed power is made to imitate the arbitrary or voluntary motions of living beings. Human figures, of this kind, are styled *Androides*, from the Greek term, *like a man*.

The moving power of almost all automata is a wound-up steel spring; because, in comparison with other means of giving motion, it takes up the smallest room, is easiest concealed, and set a-going. Weights are seldom employed, and only in a partial way. The employment of other moving powers is more limited; sometimes fine sand is made to fall on the circumference of a wheel, by which the rest of the mechanism is moved. For the same purpose water has been employed; and when it is made to fall into an air-chamber, it causes sufficient wind to excite musical sounds in pipes. In particular cases quicksilver has been used, as for example in the Chinese tumblers, which is only a physical apparatus to illustrate the doctrine of the centre of gravity.

Figures are frequently constructed for playthings, which move by wheels hardly visible. An example of this simplest kind of automaton which may be introduced here, as illustrating the self-acting principles of manufactures, is shown in the figure; it exhibits the outlines of an automaton, representing a swan, with suitably-combined movements. The mechanism may be described, for the sake of clearness of explanation, under distinct heads. The first relates to the motion of the whole figure. By means of this part it swims upon the water, in directions changed from time to time without exterior agency. Another construction gives to the figure the faculty of bending its neck on several occasions, and to such an extent that it can plunge the bill and a portion of the head under water. Lastly, it is made to move its head and neck slowly from side to side.

On the barrel of the spring, exterior to the usual ratchet wheel, there is a main-wheel, marked 1, which works into the pinion of the wheel 2. The wheel 2 moves a smaller one, shown merely black, and on the long axis of the latter, at either end, there is a rudder, or water-wheel, the paddles of which are denoted by the letter *a*. Both of these rudder-wheels extend through an oblong opening in the bottom of the figure down into the water. They turn in the direction of the arrow, and impart a straight-forward movement to the swan. The chamber in which these wheels revolve is made water tight, to prevent moisture being thrown upon the rest of the machinery. By the wheel 4, motion is conveyed to the fly-pinion 5; the fly itself 6, serves to regulate the working of the whole apparatus, and it is provided with a stop bar, not shown in the engraving, to bring it to rest, or set it a-going at pleasure. Here, as we may imagine, the path pursued is rectilinear, when the rudder-wheels are made to work in a square direction. An oblique bar, seen only in section at *b*, movable about its middle point,

carries at each end a web foot *c*, so that the direction of the bar *b*, and of both feet towards the rudder wheels, determines the form of the path which the figure will describe. The change of direction of that oblique bar is effected without other agency. For this purpose, the wheel 1 takes into the pinion 7, and this carries round the crown-wheel 8, which is fixed, with an eccentric disc 9, upon a common axis. While the crown-wheel moves in the direction of the arrow, it turns the smaller eccentric portion of the elliptic disc towards the lever *m*, which, pressed upon incessantly by its spring, assumes, by degrees, the position corresponding with the middle line of the figure, and afterwards an oblique position; then it goes back again, and reaches its first situation; consequently through the reciprocal turning of the bar *b*, and the swim-foot, is determined and varied the path which the swan must pursue. This construction is available with all automata which work by wheels; and it is obvious that we may by different forms of the disc 9, modify at pleasure the direction and the velocity of the turnings. If the disc be a circle for instance, then the changes will take place less suddenly; if the disc have an outward and inward curvature, upon whose edge the end of the lever presses with a roller, the movement will take place in a serpentine line.

The neck is the part which requires the most careful workmanship. Its outward case must be flexible, and the neck itself should therefore be made of a tube of spiral wire, covered with leather, or with a feathered bird-skin. The double line in the interior, where we see the triangles *e e e*, denotes a steel spring made fast to the plate 10, which forms the bottom of the neck; it stands loose, and needs to be merely so strong as to keep the neck straight, or to bend it a little backwards. It should not be equally thick in all points, but it should be weaker where the first graceful bend is to be made; and, in general, its stiffness ought to correspond to the curvature of the neck of this bird. The triangles *e* are made fast at their base to the front surface of the spring; in the points of each there is a slot, in the middle of which a movable roller is set, formed of a smoothly turned steel rod. A thin catgut string *f*, runs from the upper end of the spring, where it is fixed over all these rollers, and passes through an aperture pierced in the middle of 10, into the inside of the rump. If the catgut be drawn straight back towards *f*, the spring, and consequently the neck, must obviously be bent, and so much the more, the more tightly *f* is pulled, and is shortened in the hollow of the neck. How this is accomplished by the wheel-work will presently be shown. The wheel 11 receives its motion from the pinion *s*, connected with the main wheel 1. Upon 11 there is, moreover the disc 12, to whose circumference a slender chain is fastened. When the wheel 11 turns in the direction of the arrow, the chain will be so much pulled on-wards through the corresponding advance at the point at 12, till this point has come to the place opposite to its present situation, and consequently 11 must have performed half a revolution. The other end of the chain is hung in the groove of a very movable roller 14; and this will be turned immediately by the unwinding of the chain upon its axis. There turns, in connexion with it, however, the large roller 13, to which the catgut *f* is fastened; and as this is pulled in the direction of the arrow, the neck will be bent until the wheel 11 has made a half revolution. Then the drag ceases again to act upon the chain and the catgut; the spring in the

neck comes into play: it becomes straight, erects the neck of the animal, and turns the rollers 13 and 14, back into their first position.

The roller 13 is of considerable size, in order that through the slight motion of the roller 14, a sufficient length of the catgut may be wound off, and the requisite shortening of the neck may be effected; which results from the proportion of the diameters of the rollers 11, 13, and 14. This part of the mechanism is attached as near to the side of the hollow body as possible, to make room for the interior parts, but particularly for the paddle-wheels. Since the catgut, *f*, must pass downwards on the middle from 10, it is necessary to incline it sideways and outwards towards 13, by means of some small rollers.

The head, constituting one piece with the neck, will be depressed by the complete flexure of this; and the bill, being turned downwards in front of the breast, will touch the surface of the water. The head will not be motionless; but it is joined on both sides by a very movable hinge, with the light ring, which forms the upper part of the clothing of the neck. A weak spring *g*, also fastened to the end of the neck, tends to turn the head backwards; but in the present position it cannot do so, because a chain at *g*, whose other end is attached to the plate 10, keeps it on the stretch. On the bending of the neck, this chain becomes slack; the spring *g* comes into operation, and throws the head so far back, that, in its natural position, it will reach the water.

Finally, to render the turning of the head and the neck practicable, the latter is not closely connected with the rump, while the plate 10 can turn in a cylindrical manner upon its axis, but cannot become loose outwardly. Moreover, there is upon the axis of the wheel 1, and behind it (shown merely as a circle in the engraving) a bevel wheel, which works into a second similar wheel, 15, so as to turn it in a horizontal direction. The pin 16, of the last wheel, works upon a two-armed lever 19, movable round the point *A*, and this lever moves the neck by means of the pin 17. The shorter arm of the lever 19 has an oval aperture in which the pin *d* 6 stands. As soon as this, in consequence of the movement of the bevel-wheel 15, comes into the dotted position, it pushes the oval ring outwards on its smaller diameter, and thereby turns the lever upon the point *A*, into the oblique direction shown by the dotted lines. The pin 16, having come on its way right opposite to its present position, sets the lever again straight. Thereby the lever, by the further progress of the pin in its circular path, is directed outwards to the opposite side; and, at last, when 15 has made an entire revolution, it is quite straight. The longer arm of the lever follows, of course, these alternating movements, so that it turns the neck upon its plate 10, by means of the pin 17; and, as 18 denotes the bill, this comes into the dotted position. It may be remarked in conclusion, that the drawing of the *fig.* represents about the size of which the automaton may be constructed, and that the body may be formed of thin sheet-copper or brass.

Figs. 2, 3, and 4, show the plan of a third automaton. A horse which moves its feet in a natural way, and draws a carriage with two figures sitting in it. The man appears to drive the horse with a whip; the woman bends forwards from him in front. The four wheels of the carriage have no connexion with the moving mechanism. The wheel 7, *fig. 2*, operates through the two carrier wheels upon the wheels marked 4 and 5. By means of the axis of these two wheels, the feet are set in motion. The

left fore-foot *a*, then the right hinder foot, move themselves backwards, and take hold of the ground with small tacks in their hoofs, while the two other legs are bent and raised, but no motion of the body takes place. The carriage, however, with which the horse is connected, advances upon its wheels. By studying the mechanism of the foot *a*, and the parts connected with it, we can readily understand the principles of the movement. The axis of wheel 4 is crank-shaped, on both sides, where it has to operate directly on the fore feet; but for each foot, it is bent in an opposite direction, as is obvious in the front view *fig. 4*. This crank, or properly its part furthest from the axis, serves instead of the pin 16, in the swan, and moves like it in an oval slot, *p*, *fig. 3*, a two-armed lever, which gives motion through tooth-work, but not as in the swan, by means of a second pin. This wheel-work fenders the motion smoother. The above lever has its fulcrum at *n*, 3, about which it turns alternately, to the one and the other side, by virtue of the rotation of the wheel 4. The toothed arch, or the half-wheel on the under side, lays hold of a shorter lever, in a similar arch, upon the upper joint of the foot, which is moved forwards and backwards upon the pivot *m*. In virtue of the motions in the direction of the arrow, the foot *a* will move itself first obliquely backwards, without bending, and the body will thereby bend itself forwards. When the right hind foot makes the same motion, both the other feet are raised and bent. The joints of the foot at *d* and *e* are formed of hinges, which are so constructed that they can yield no farther than is necessary at every oblique position of the foot. With the continued rotation of the wheel 4, the lever turns itself about *n*, in an inverted direction inwards, and impels the uppermost foot-joint forwards, so that it forms an acute angle with the body in front. The foot is now twice bent upon its joints. This takes place by the traction of the chain *t*, which is led over rollers (as the drawing shows) to the foot, and is there fastened. As its upper end has its fixed point in the interior of the body, it is therefore drawn by the eccentric pin *r* standing in the vicinity of *m*, and thus bends the foot at the hinges. If there were space for it, a roller would answer better than a pin. By the recedure of the uppermost joint into the first position, the tension of the chain *t* ceases again of itself, while the pin *r* removes from it, and the foot is again extended in a straight line by the small springs operating upon its two under parts, which were previously bent stiffly by the chain. By the aid of the figures with this explanation, it will be apparent that all the fore feet have a similar construction, that the proper succession of motions will be effected through the toothed arcs, and the position of the cranks on the axis of the wheels 4 and 5, and hence the advance of the figure must follow. The wheel 6 puts the fly 7 in motion, by means of the small wheel marked 1; in the fixed points of the 4 chains, by means of a ratchet-wheel and a catch, the necessary tension will again be produced when the chains have been drawn out a little. There is sufficient room for a mechanism which could give motion to the head and ears, were it thought necessary.

The proper cause of the motions may now be explained. In *fig. 2*, *a* is a wheel connected with the wound-up spring, by which the motion of the two human figures, and also, if desired, that of the horse may be effected. The axis of the wheel *b* carries a disc with pins, which operate upon the two-armed lever with its fulcrum *c*, and thus cause the

bending of the upper part of one of the figures, which is a hinge at *f*. On the axis of that wheel there is a second disc *c*, for giving motion to the other figure; which, for the sake of clearness, is shown separate, although it should sit alongside of its fellow. On the upper end of the double-armed lever *d*, there is a cord whose other end is connected with the moving arm, in the situation *i*, and raises it whenever a pin in the disc presses the under part of the lever. A spring *h* brings the arm back into the original position, when a pin has passed from the lever, and has left it behind. The pins at *c* and *d* may be set at different distances from the middle of the disc, whereby the motions of the figures by every contact of another pin are varied, and are therefore not so uniform, and consequently more natural.

For the connexion of both mechanisms, namely, the carriage with the horse, various arrangements may be adopted. Two separate traction springs should be employed; one at *a*, *fig. 2*, in the coach-seat: the other in the body of the horse. In the coach-seat at *b*, the fly with its pinion, as well as a ratchet-wheel, is necessary. By means of the shaft, the horse is placed in connexion with the carriage. It may, however, receive its motion from the spring in the carriage, in which case one spring will be sufficient. Upon the latter plan the following construction may be adopted:—To the axis of *b*, *fig. 3*, a bevel wheel is to be attached, and from this the motion is to be transmitted to the bottom of the carriage with the help of a second bevel wheel *e*, connected with a third bevel wheel *f*. This again turns the wheel *u*, whose long axis *v* goes to the middle of the horse's body, in an oblique direction, through the hollow shaft. This axis carries an endless screw *g*, *fig. 3*, with very oblique threads, which works into the little wheel *h*, corresponding to the wheel *l*, through an opening in the side of the horse, and in this way sets the mechanism of the horse a-going. With this construction of *fig. 2*, a spring of considerable strength is necessary or if the height of the carriage-seat does not afford sufficient room, its breadth will answer for placing two weaker springs alongside of each other upon a common barrel.

DICTIONARY OF TRADE, COMMERCE, AND NAVIGATION.

It is but about once in each year that we introduce into our Magazine any thing relative to our own affairs, and should not do so even then, but in hopes of introducing to our readers a something which they may find useful. We projected three years since a series of cheap Dictionaries, each to be complete in itself, and altogether to form a concentrated library upon the various departments of human knowledge. The first of these, "The Dictionary of Arts and Sciences,"* met with very great success; so much so indeed, that we have thought it advisable to have a re-issue of it this season, in the original form of 1½d. numbers. The second Dictionary was on the Experiments of Philosophy, &c. One half of this, namely, "Chemical Experiments,"† is now complete, and we are collecting materials for the

* "The Dictionary of Arts, Sciences, and Manufactures;" now complete, at 10s. bound; in 15 parts at 7d.; or in numbers at 1½d.—now re-issuing.

† "Chemical Experiments: or the whole theory, practice, and application of the Science of Chemistry;" complete at 6s., in 8 parts at 7d.; or in numbers. This is the same as the "Dictionary of Experiments," and in parts and numbers will be asked for as such.

second part on Natural Philosophy; the part published is however distinct in itself, and gives an account of making, testing, and experimenting with all useful chemical substances whatever. A third Dictionary is now commenced, to include every thing relating to trade and business; commerce and navigation; its objects, laws, and terms; public affairs, places, flags, monies, shipping, fisheries, &c. &c.; the whole corrected up to the latest period, and illustrated by hundreds of wood cuts. To give such extracts from the work, as may show to our readers its comprehensiveness, and at the same time to keep those extracts accordant with the usual subjects of this Magazine is difficult, if not impossible; we will therefore beg their indulgence for the small deviation from science which we are obliged to make, intending, however, only to give four or five short extracts, to show how the various subjects will be treated; and to inspire confidence, we may state, that the greatest diligence will be given to every part.

The work is now publishing in weekly numbers at 1½d., and monthly parts at 7d.

"**ARBROTHICK, ARBROATH.** A sea port on the East of Scotland seated upon the confluence of the river Brothick with the sea. Its exports are sail-cloth, linen, thread, and a little corn; its imports flax, flax-seed, and timber. The spring tides rise here 15 feet, but its harbour is dry at low water. Twelve miles off the coast, opposite Arbroath, is the celebrated Bell-rock light-house; the building of which is considered a master-piece of skill, next in difficulty to that of Eddystone. It is a beautiful structure.



"**ACCOMMODATION BILL.** A false bill of exchange, that is, one drawn solely for the purpose of being discounted, or paying away without any value having been given for it. This is called an accommodation or fictitious bill, a kite, a wind bill, &c. The nature of such a document is as follows.—A and B are known to each other. A draws upon B for £20 at three months. B accepts the bill upon an understanding that A shall, at the proper time, furnish him with the means of taking it up. A having obtained this acceptance indorses the bill with his own name, and gets it discounted upon the joint credit of the two names, paying a discount, and receiving the balance, which may be perhaps £19, according to the discount he agrees to pay. This puts him in ready money for the time. Previous to the bill becoming due he furnishes B with £20 to take up the bill. If A obtain this money from other sources, the whole transaction is concluded, and the only effect is, that A has paid £1 for the use of the money during three months; but it mostly happens that A is obliged to draw and discount a second bill to pay the first; a third perhaps to pay the second; and so on, till the high and continued discounts, expense of stamps, and loss of credit, generally exhaust his expedients, and bankruptcy ensues.

"ACRE. A measure of land, containing 4 roods, or 160 square rods, or 4,840 square yards, or 10 square chains; and 160 acres make a mile of land. One Scotch acre is equal to 1.2612 Eng. acres, or 134 88. acres—169 Eng. very nearly; 30½ Irish acres are equal to about 49 English. The first mentioned is the only standard acre for England, yet the perch or pole, still varying by custom, though not by law, affects the size accordingly of the acre. When land is bought or sold by the acre, the standard English acre is always understood. Let it be remarked, that in buying land there are two ways of measurement; the one the landlord's or selling measure, including the hedges, fences, and ditches, and growing bushes and underwood in the divisions between closes; and the other the tenant's or agricultural measure, including only the ploughing or mowing acre; a distinction sometimes essential to be remembered.—*Bateman's Law of Auctions*, p. 20. *

"ADMIRALTY, BOARD OF. The board of admiralty is distinguished from the court of admiralty in being executive, while the other is judicial; therefore, it is to be considered merely as a division of the national maritime management. It is the privilege of the board of admiralty to order the building, repairing, fitting for sea, laying up in ordinary, breaking up, selling, putting in and out of commission, arming, stowing, provisioning and appointing to stations the whole navy of Britain. All commissions, pensions, superannuations, and promotions, are regulated or recommended by them. Instructions issued to commanders, payment of all naval monies, all improvements, alterations and repairs to dock yards, &c., emanate from the admiralty. They also render quarterly an account of the state of discipline and order of the various parts of the fleet, and prepare the navy estimates to be presented annually to parliament. (A portion of the above duties are performed by the navy board and the victualling board.) The office at which the lord commissioners of the admiralty hold their sittings is situated at Whitehall, in the building represented beneath.



"Ordinary communications to the board of admiralty are by petition, (see *Petition*;) or, by letter. In both cases addressed:—

"To the Right Honorable
the Lords Commissioners
of the Admiralty."

"The proper commencement of such a letter is *My Lords*. Its conclusion is as follows:—

"I have the honor to be,
My Lords,
Your Lordships' most obedient
humble Servant."

"It is only by courtesy that the title of *Right Honorable* is annexed to the superscription.

"ANCHOR. A heavy iron instrument, with a

double hook at one end, and a ring at the other, by which it is fastened to a cable, and dropped from a ship into the bottom of the sea, where taking its hold it keeps her in a proper situation from being driven away by the winds or waves. It is composed of a ring at top, next of a shank or iron rod, extending from the ring to the arms, which arms are terminated by palms or flukes, the sharp points of which are called the bills. The outward angular point of the two arms at the extremity of the shank is called the throat of the arms. The thin part of the arms under the palms is called the trend. The crown is where the arms are joined to the shank. The small round is the diameter where the shaft is smallest, which is near the square part where the stock is fixed, and the stock is the beam of wood fixed on the extremity of the shank, at right angles to the plane which passes through the arms. Its length is that of the stock added to half the diameter of the ring.



"Anchors vary in weight from 1 to 95 cwt., one of this weight being in Portsmouth dock yard. The names of the anchors at present in use are the *sheep* anchor, which is the largest and strongest, being that which seamen call their last hope, and never to be used but in great extremity. The *best bower* anchor and *little bower* anchor are a little different in size, and take their names from the situation where they are placed, being carried on the bows of the ship. The *stream* anchor, which is less than the preceding, and the *kedg* anchor, which is the smallest of all, except the *pilot's* anchor. This is a small anchor, used mostly by pilots for dropping a vessel in a stream or tide's way. With respect to the situation when in the ground they are sometimes denominated the *flood* anchor and the *ebb* anchor or those by which the ship rides during the flood or ebb tide. The *sea* anchor or that towards the offing, and the *shore* anchor or that between the ship and the shore.

"APOTHECARIES COMPANY. A trading company of London, first incorporated with the grocers in the year 1606; their arms are represented beneath.



English of motto—"And I am known as an activer throughout the world."

"In 1617 they were constituted a sole corporation, and in 1712 they were by the 12th of Anne, which was made perpetual by 9 Geo. I, exempted from serving on juries, and ward and parish offices. The society is held at a hall in Blackfriars, and is governed by a master, wardens, and court of assistants. Every kind of drug and chemical substance is sold in their hall, and chemical operations conducted in their laboratory. There is also a court of examiners, who by the statute 55 Geo. III, c 194, are empowered to require every person, previous to practising as an apothecary, in either England or Wales, to pass an examination before them, and to obtain the certificate of his proficiency, under a penalty of £20 for every time he practices without such certificate. An apothecary is one who prescribes medicine and also sells it; if he merely sell it he is a chemist and druggist; if he prescribe only he acts as a physician. If apothecaries refuse to prepare or administer, or negligently and fraudulently prepare, administer, or sell any medicines or medicinal compositions, they forfeit for the first offence £5; for the second £10; and for the third their certificate; are rendered incapable in future of acting as apothecaries, and are subject to the penalty inflicted for acting without a certificate.

"**ARACHIS NUT, GROUND NUT.** The ground nut, sufficiently common in the West Indies, is brought here more as an article of curiosity than usual consumption, yet it may be generally procured at the chief grocers in the winter season. It is of a light brown color, of an oblong shape, yields an immense quantity of a fine bland oil valuable for domestic purposes, for illumination, and for soap; a bushel of arachis nuts producing 1 gallon of oil when expressed cold, and a still greater quantity if heat be applied. The arachis is indigenous to S. America, and is universally cultivated in the W. Indies, and lately in the S. of France, for the sake of its seeds. It is an annual plant with long stalks trailing on the ground; these are furnished with winged leaves, composed of four hairy lobes. The flowers, which grow singly on the long stalks, are yellow, and of the pea kind. These are followed by oblong pods, each containing three or four seeds. The manner in which the seeds come to perfection is very singular; as the flowers fall off the young pods are forced to the ground by a natural motion of the stalks, and are so entirely buried as not to be discovered without digging for them, hence they have obtained the name of ground nuts. The duty is 20 per cent.



"**ARGUS FEATHERS.** The wing feathers of the Sumatran or Argus pheasant, the plumage of which is equal to the richest and most magnificent of the whole feathered tribe. The bird is intermediate in character between the peacock and the pheasant, and spreads its wings in like manner to the tail of the first, but is destitute of the peacock's brilliant colors, being covered almost entirely with dark rings or eye-like spots, upon a cinnamon colored ground. It is an exceedingly shy bird; thus little is known of its habits."



THE BINARY THEORY OF SALTS.

(Resumed from page 308, and concluded.)

THE theory of substitutions, recently propounded by Dumas, founded in the replacements which take place in the formation of certain organic bodies, is also strongly corroborative of the truth of the view of the constitution of salts now under discussion; the whole series of cases of solution of metals in acids and formation of salts, being according to it all cases of substitution.

But the principal and crowning argument in favor of this theory, amounting indeed to almost actual demonstration, is derived from the phenomena which occur upon the electrolyzation of either salt or acids. Water in a state of purity is very difficult of decomposition by voltaic electricity, requiring a battery of very considerable power, but is easily resolved into its elements on the addition of a little acid or neutral salt, and this increased facility of decomposition is usually accounted for by supposing that the addition causes an increase in the conducting power of the solution, or by some other inexplicable means. But on the binary theory of saline bodies the phenomena are unattended with the slightest difficulty; it is no longer water, but a salt which is decomposed. In the case of sulphuric acid having been added, sulphatoxide of hydrogen is the body which suffers decomposition, the hydrogen being evolved at the cathode, while the sulphatoxygen upon its arrival at the anode, (from its affinity for hydrogen, not being capable of existing in an isolated state,) decomposes by chemical action only an equivalent of water, appropriating the hydrogen, and letting the oxygen escape; so that by the united effects of the direct and secondary action, we obtain as the results the

elements of water. When sulphate of soda exists in the water of the decomposing cell of a voltaic arrangement, it is sulphatoxide of sodium which is decomposed, soda and hydrogen appearing at one electrode, and sulphuric acid and oxygen at the other. In fact the decomposition of this, or a similar salt, when made in a proper apparatus, by which all the products are collected, and with suitable precautions, constitutes what may be considered as an *experimentum crucis* in favor of the binary theory. To perform it, a solution of this salt should be colored with a vegetable blue, and placed in a glass vessel, divided by a porous diaphragm into two portions. The vessel should be closed at top, and have a bent tube proceeding from each division to a pneumatic trough. A platinum electrode being fixed in each cell, the apparatus is placed in the voltaic circuit, and the connexions completed, a tube containing fused chloride of lead being also included in the circle. Now upon the transmission of the voltaic force, decomposition ensues, a free acid being developed at the anode in the glass vessel, shown by the reddening of the solution in that division, while oxygen gas is at the same time given off by the tube. In the other division, soda, demonstrating its presence by the green color which it develops, is produced, and hydrogen given off, and upon collecting the products, it will be found that we have the elements of one equivalent of sulphate of soda, and also of one equivalent of water, as the results at this part of the circuit; while at the same time, in another part, only one equivalent of the chloride of lead will be found to have suffered decomposition.

Now it is manifestly absurd to suppose that the voltaic current, which in one part of its circuit is only capable of decomposing a single equivalent of a substance, can in another decompose, at the same time, an equivalent of each of two bodies, one of them, the water, being when alone, (as it must be considered here,) of exceedingly difficult decomposition, and yet we must in the old theory assume such to be the case. On the other hand, the explanation of these phenomena in the binary theory is at once simple and satisfactory. The body electrolyzed is sulphatoxide of sodium; the direct decomposition, caused by the voltaic force, is into the salt radical, sulphatoxygen, (SO_2) and the metal sodium. These bodies are evolved at the electrodes, and both of them being incapable of existing in an insulated state, when in contact with water, severally decompose an equivalent of that body; the sulphatoxygen combining with hydrogen, and evolving the oxygen, (sulphuric acid being thus again developed,) causing the characteristic coloring of the solution; and the sodium appropriating oxygen, forming the alkali, changing the color in that division, and giving off the hydrogen not wanted. Thus all the results are clearly explained, on the footing of only a single decomposition taking place, corresponding in effect with the force measured by the decomposition of the admitted binary chloride, without being obliged to have recourse to the other more complicated and unnatural supposition.

The decomposition of metallic salts, such as sulphate of copper, in electrotype operations, is also explained on the same principle with the like success. Sulphatoxide of copper is decomposed, the copper going direct to the cathode, and not being a metal which decomposes water by chemical action, as sodium does, is precipitated in the reduced state, while the sulphatoxygen combines with an equivalent of copper, (supposing the anode to consist of that

metal,) to replace the one from which it has just been separated, and by this means the solution is kept always at the same point of saturation. Should the electrodes be of platinum, the copper will be reduced at the cathode as before, but the sulphatoxygen, not being able to combine with the metal of the anode, decomposes water, and reforms sulphuric acid; the superfluous oxygen being given off. On the old theory, sulphate of copper was said to be resolved into acid and oxide, and water into oxygen and hydrogen at the same time. The hydrogen thus obtained reduced the oxide of copper to the metallic state by secondary action, uniting with the oxygen to reconstitute water, and the oxygen combined with the copper anode, to fit it for solution in the acid, or was evolved in the case of a platinum electrode. A single glance at the two different modes of explanation definitively shows the superiority of the binary doctrine.

Such is a sketch of the leading propositions of, and facts relative to the new theory. Its principal advantages appear to consist in—First, the generalization, that, instead of two, it makes but one great class of salts, assimilating in composition bodies which certainly resemble each other in properties. Chloride of sodium and sulphate of soda are both neutral, and possess a common character, which is that of a soda salt, but they are separated widely from each other on the ordinary view of their constitution, which is expressed in their names.

Secondly. It accounts for a remarkable law which is observed in the construction of salts; viz. that bases always combine with as many atoms of acid as they themselves contain of oxygen. A protoxide, which contains one atom of oxygen, combining and forming a neutral salt with one atom of an oxygen acid. While an oxide which contains two atoms of oxygen to one of metal, like peroxide of tin, forms a neutral salt with two atoms of acid; and an oxide of three atoms of oxygen to two of metal, like peroxide of iron, forms a neutral salt with three atoms of acid. The acid and oxygen are thus always together in the exact proportion to form the salt radical, there being always an atom of oxygen for every atom of acid in the salt.

Thirdly. It offers a more simple and philosophical explanation of the action of certain metals upon acid solutions, and of the decomposition of such solutions by electricity, and under other circumstances. Its operation in elucidating these phenomena has already been fully shown.

As opposed to these advantages, the only objection to which the theory appears open is the one of multiplication of imaginary radicals. This point we have previously referred to, and satisfactorily disposed of.

T. M. B.

* PROTECTION FROM FIRE.

As at this season of the year fires are unfortunately so numerous, and as some which have lately occurred have been so awfully destructive to human life, every thing connected with the important subject of preservation from that destructive element, must and ought to possess an interest even to those who are themselves, or who imagine themselves, removed from personal danger. With this view we introduce a paper on the Chevallier Aldini's incombustible dresses, which have been tried in this and other countries, and found successful; yet strange to say have never been generally adopted, although had a single fireman been thus protected at the late la-

mentable fire in Whitechapel, in all probability some lives would have been spared. But to proceed to the subject itself.

The incombustible character of cloth made of the asbestos was known to the ancients, and used by them to inclose the bodies laid upon the funeral pile, and thereby to preserve their ashes, is a matter of notoriety. The art of weaving such cloth, and of course the employment of it, was lost in the darkness of the middle ages. Its revival and improvement we owe to the benevolence and ingenuity of the Chevalier Aldini, of Milan, who has travelled through all Europe to present this valuable gift to his species. Sir H. Davy had long ago shown that a safety lamp for illuminating mines, containing inflammable air, might be constructed of wire-gauze alone, which prevented the flame within, however large or intense, from setting fire to the inflammable air without. This valuable property, which has been long in practical use, he ascribed to the conducting and radiating power of the wire-gauze, which carried off the heat of the flame, and deprived it of its power. The Chevalier Aldini conceived the idea of applying the same material, in combination with other badly-conducting substances, as a protection against fire. The incombustible pieces of dress which he used for the body, arms, and legs, are formed out of strong cloth, which has been steeped in a solution of alum, while those for the head, hands, and feet, are made of cloth of asbestos or amianthus. The head dress is a large cap, which envelops the whole head down to the neck, having suitable perforations for the eyes, nose, and mouth. The stockings and cap are single, but the gloves are made of double amianthus cloth, to enable the fireman to take into his hand burning or red hot bodies. The piece of ancient asbestos cloth preserved in the Vatican was formed, we believe, by mixing the asbestos with other fibrous substances; but M. Aldini has executed a piece of nearly the same size, 9 feet 5 inches long, and 5 feet 3 inches wide, which is much stronger than the ancient piece, and possesses superior qualities, in consequence of having been woven without the introduction of any foreign substance. In this manufacture the fibres are prevented from breaking by the action of steam, the cloth is made loose in its fabric, and the threads are about $\frac{1}{8}$ of an inch in diameter.

The metallic dress which is superadded to these means of defence consists of five principal pieces, viz. a casque or cap, with a mask large enough to leave proper space between it and the asbestos cap; a cuirass with its brasses; a piece of armour for the trunk and thighs; a pair of boots of double wire-gauze; and an oval shield, 5 feet long by 2½ wide, made by stretching the wire-gauze over a slender frame of iron. All these pieces are made of iron wire-gauze, having the interval between its threads the $\frac{1}{2}$ part of an inch.

In order to prove the efficacy of this apparatus, and inspire the firemen with confidence in its protection, he showed them that a finger first enveloped in asbestos, and then in a double case of wire-gauze, might be held a long time in the flame of a spirit-lamp or candle before the heat became inconvenient. A fireman having his hand within a double asbestos glove, and its palm protected by a piece of asbestos cloth, seized with impunity a large piece of red hot iron, carried it deliberately to the distance of 150 feet, inflamed straw with it, and brought it back

again to the furnace. On other occasions the fireman handled blazing wood and burning substances, and walked during five minutes upon an iron grating placed over flaming fagots.

(To be continued.)

MAKING NITROGEN GAS.

(To the Editor.)

SIR,—In a paper on the preparation of gases in your third volume, you give the old method of procuring nitrogen, which is very inconvenient in many respects, I beg to offer the following methods which may probably be new to some of your readers. The first is a process introduced by Professor Gunn, and is extracted from the "Journal of the Roy. Ins."

A tubulated retort is partly filled with nitrate of ammonia, previously deprived of its water of crystallization by drying, and a cork adapted to the tubulure. Through the cork is to be passed freely a knitting needle or iron wire, having attached to its lower end by means of a hook a piece of zinc wire in the form of a coil, or a smaller rod of zinc. The coil is preferable as it presents the metal in a state more favorable to chemical action than in a larger form.

As soon as the salt is fused, the iron wire is to be pushed carefully down so as to bring the zinc into contact with the salt. If it is pushed too far into the fused salt, the disengagement of gas is too violent; and on the contrary unless perfect contact is constantly maintained, a vacuum may be formed in the retort. Every grain of zinc furnishes nearly a cubic inch of nitrogen. The nitric acid of the salt is decomposed by the zinc which is probably converted into the peroxide, the nitrogen and ammonia are disengaged, the latter being condensed by the water of the pneumatic trough, and the nitrogen is received in any vessel placed for the purpose. The second method is by decomposing ammonia by means of chlorine. For this purpose, the materials for generating chlorine may be placed in a retort or flask, having its neck inserted in liquid ammonia, contained in a tubulated receiver. A bent tube is adapted to the tubulure of receiver, and the other extremity is plunged into the water of the pneumatic trough. Upon heating the retort, the chlorine is disengaged, and being conveyed to the liquid in the receiver, combines with its hydrogen, forming hydro-chloric acid, whilst the nitrogen escapes by the bent tube to the cistern, and is there collected.

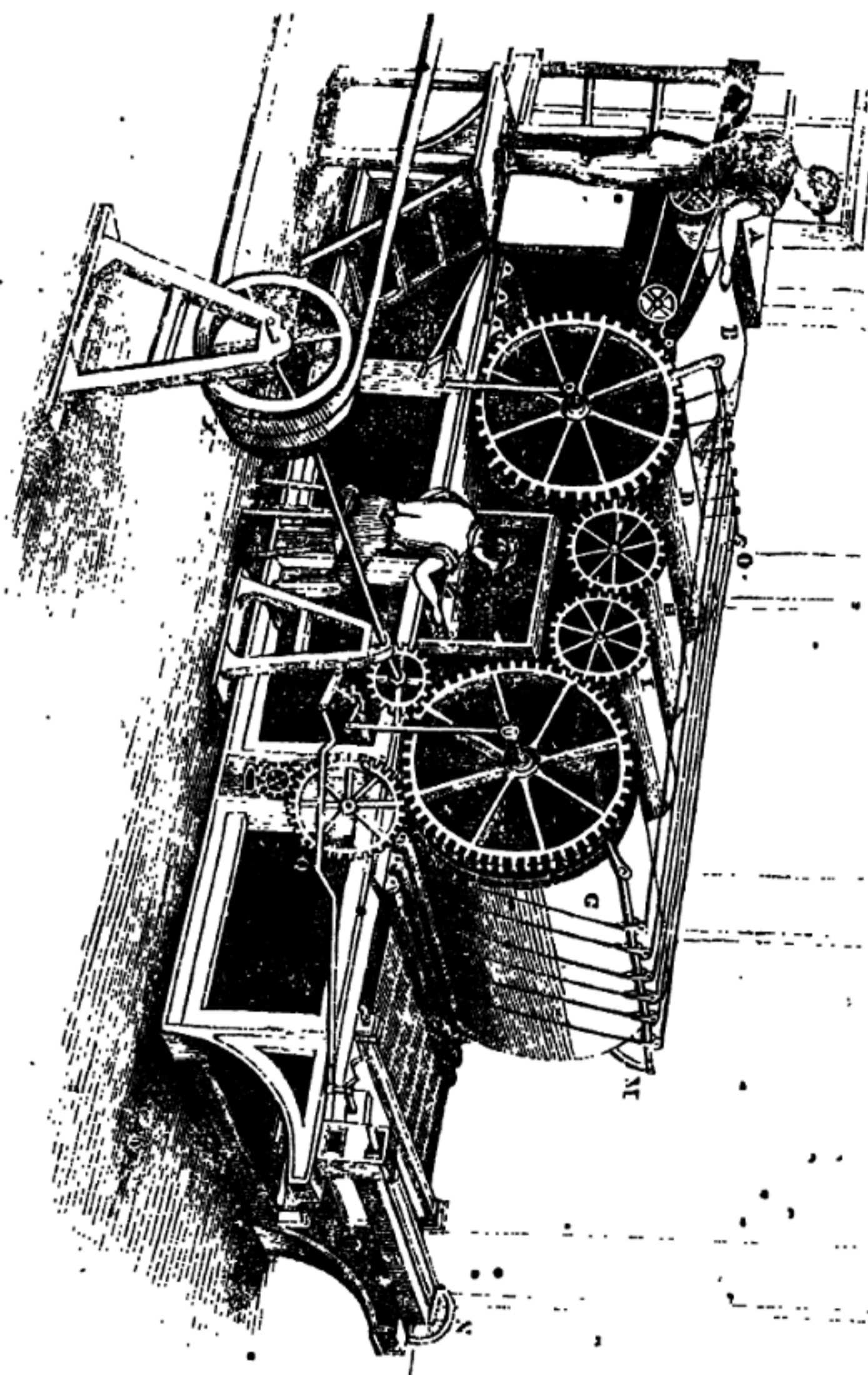
Ipswich, Dec. 1842.

WILLIAM THOMPSON.

QUERIES.

11. *What is the composition for storm glasses?*
—We have answered this question once before, in vol. 1, p. 112, where is an account of the indications given by this curious glass; but we have since had reason to believe that the receipt given for filling them is scarcely to be depended upon. We therefore now give a second receipt copied from the "Cyclopedia of Practical Receipts;" of its efficacy however we cannot vouch. Camphor 4 parts, nitre 3, sal ammoniac 1, alcohol 32; dissolve and keep in a glass tube or long phial.

12. *What is pearl white and how prepared?*
—Dissolve nitrate of bismuth in water, or else the metal itself in dilute nitric acid, then add weak salt and water until the whole of the bismuth is precipitated; collect, wash, and dry the powder with great care.



THE PRINTING PRESS.

THE PRINTING MACHINE.

PRIOR to the introduction of printing machines, the press department was one of great labour, whenever extraordinary expedition was required. It was particularly the case with newspapers, of which, with the utmost exertions, scarcely ever more than 750 copies could be obtained in an hour: the consequence was, that in newspaper offices where the circulation was extensive, it was found necessary, in order to get the paper published in time, to compose two or more copies; so that, by going to press at the same time, the demands of the public might be complied with, thus occasioning an enormous increase of expenditure both in the compositors' and press department. In a newspaper circulating 7 or 8000 copies, this expense amounted annually to at least £2000, all of which has been saved by the introduction of machines.

The little diagrams that are inserted will serve to explain, in a very clear and concise manner, the leading principle or arrangements of the inventions described, respecting which it is also necessary to observe, that—

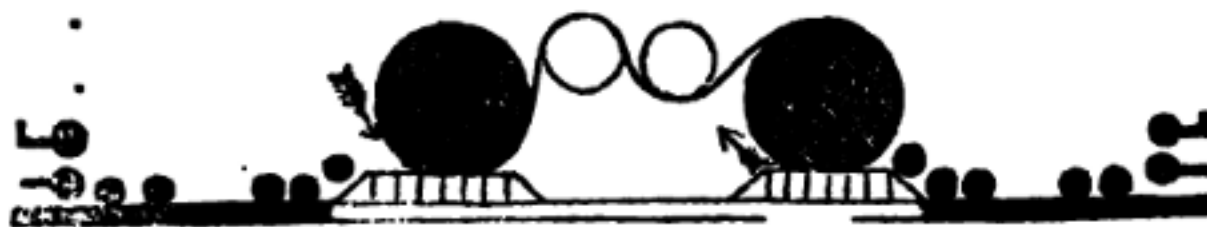
The black parts represent the inking apparatus.
The diagonal lines „ the paper cylinders.
The perpendicular lines the types or plates.
The arrows „ the track of the paper.

The first working printing machine was the invention of Mr. T. Koenig, a native of Saxony; he submitted his plans to Mr. T. Bensley, the celebrated printer, and to Mr. R. Taylor, the scientific editor of the *Philosophical Magazine*. These gentlemen liberally encouraged him, and in 1811 he took out a patent for improvements in the common press, which, however, produced no favorable result. He then turned his attention to the use of a cylinder, in order to obtain the impression, and two machines were erected for printing *The Times* newspaper, the reader of which was told, on the 28th of November, 1814, that he held in his hand a newspaper printed by machinery, and by the power of steam.

In these machines the type was made to pass under the cylinder, on which was wrapped the sheet of paper, the paper being firmly held to the cylinder by means of tapes; the ink was placed in a cylindrical box, from which it was forced by a powerful screw, depressing a tightly-fitted piston; thence it fell between two iron rollers: below these were placed a number of other rollers, two of which had, in addition to their rotatory motion, an end motion, that is, a motion in the direction of their length; the whole system of rollers terminated in two, which applied the ink to the types. In order to obtain a great number of impressions from the same



Koenig's Single Machine, for printing one side of the sheet.



Applegath and Cowper's Double Machine.

form, a paper cylinder, (i.e. a cylinder on which the paper is wrapped) was placed on each side of the inking apparatus, the form passing under both. The machine produced 1100 impressions per hour; subsequent improvements raised them to 1800 per hour.

The next step was the invention of a machine, (also by Mr. Koenig,) for printing both sides of the sheet; it resembled two single machines, placed with their cylinders towards each other, at a distance of two or three feet. The sheet was conveyed from one paper cylinder to the other by means of tapes; the track of the sheet exactly resembled the letter S, if laid horizontally, thus, *co*. In the course of this track the sheet was turned over. At the first paper cylinder it received the impression from the first form, and at the second paper cylinder it received the impression from the second form; the machine printed 750 sheets, on both sides, per hour. This machine was erected for Mr. T. Bensley, and was the only one Mr. Koenig made for printing on both sides the sheet; this was in 1815.



Koenig's Double Machine, for printing both sides of the sheet.

In 1815 Mr. Cowper obtained a patent for curving stereotype plates for the purpose of fixing them on a cylinder. Several of these machines, capable of printing 1000 sheets per hour on both sides,* are at work at the present day; and twelve machines on this principle were made for the Bank of England a short time previous to the issue of gold.



Cowper's Double, for printing both sides of the sheet.

These machines are only applicable to stereotype plates, but they formed the foundation of the future success of Applegath and Cowper's printing machinery, by showing the best method of furnishing, distributing, and applying the ink. In order to apply this method to a machine capable of printing from type, it was only necessary to do the same thing in an extended flat surface or table, which had been done on an extended cylindrical surface; accordingly Mr. Cowper constructed a machine for printing both sides of the sheet from type, securing by patent the inking apparatus, and the mode of conveying the sheet from one paper cylinder to the other by means of drums and tapes.

Mr. A. Applegath, who was a joint proprietor with Mr. Cowper in these patents, obtained patents for several improvements. Mr. Cowper had given the end motion to the distributing rollers by moving the frame to and fro in which they were placed. Mr. Applegath suggested the placing of these rollers in a diagonal position across the table, thereby producing their end motion in a simpler manner.

In *The Times* machine, which was constructed on the joint invention of Messrs. Applegath and Cowper, the form passes under four printing cylinders, which are fed with sheets of paper by four lads, and after the sheets are printed they pass into the hands of four other lads; by this contrivance 4000 sheets per hour are printed on one side.

The engraving affords a general or perspective view of one of Messrs. Cowper and Applegath's double machines. A boy is represented as standing upon a platform, with a pile of paper A on a table on his left hand, from which he has taken a sheet of paper B, and is applying it to the machine. It first goes under the cylinder D, and is there printed on one side; it is then conducted over the intermediate cylinders H I, on to the cylinder G, passing round this, and underneath; the sheet of paper is thereby turned with its opposite side against the type, and receives the second or finishing impression, and is then conducted to the top of the pile of printed sheets, where a boy at Z is shown sitting on a stool, and receiving the sheets as they are presented, and laying them square on the pile before him. The separate forms of types designed to print both sides of the sheet are placed at the requisite distance asunder, upon one long bed mounted on a carriage, which is moved backwards and forwards upon a railway, constructed to guide the carriage with great accuracy into contact with the cylinders F and G, to produce the impression. The reciprocating motion of the carriage is effected by a pinion fixed upon the end of a vertical spindle, taking into the teeth of an endless rack, which is connected by a system of levers with the type carriage, in such a manner, that when the pinion is turned round, it engages, at alternate periods, in the teeth formed on the opposite sides of the rack, and consequently on the opposite circumference of the pinion; thereby a continuous motion of the pinion communicates a reciprocating motion to the rack and carriage. The vertical spindle is turned by a couple of bevelled wheels, from the pinion P, which receives its motion by an intermediate wheel Q from the toothed wheel upon the end of the main cylinder G. An inking apparatus is situated at each end of the machine. At N one of these is brought into view; it consists of a cylindrical metal roller, which has a slow rotatory motion, communicated to it by a catgut band passing round a small pulley upon the end of the axis of the main cylinder G. The roller at N is adapted to carry down a thin film of ink upon its circumference, by turning in contact with a mass of ink disposed upon a horizontal plate of metal, the edge of which plate is ground straight, and the distance between the two surfaces is adjusted by screws. Upon an axis turning at P is mounted a composition roller, connected by cranked levers with a small eccentric circle fixed upon the end of the axis of the cylinder G, causing it to move round the axis P, and remain for a short period in contact with the face of the ink-roller N, thereby receiving a portion of ink upon its surface: it then descends and rests with its whole weight upon the surface of the table, which is affixed to the end of the type-carriage, the reci-

procating motion of which causes the ink-table to receive ink upon its surface from the elastic roller before mentioned. In this situation, when the type-carriage returns, the surface of the table is made to pass under three elastic rollers; these rollers are mounted upon pivots in a frame, in such manner that they have liberty to move somewhat up and down, in order that the rollers themselves may bear severally upon the surface of the table; and to equalize the ink perfectly over the table, an end motion is given to the rollers by means of inclined planes, against which they come into contact; and by the further motion of the type-carriage, the ink-table is caused to pass under four other small elastic rollers, which in like manner bear with their weight upon the surface of the table, and thereby take up the ink upon their circumferences, which they impart to the types as the form travels backwards and forwards under them, thus touching every type eight times. Whilst this operation of inking the types is going on at one end of the machine, the printing process is performed at the other end on one of the sides of the sheet from the types last inked, and *vice versa*.

PHYSIOLOGY AND CLASSIFICATION OF INSECTS.

Insects are distinguished from worms by always having feet in their perfect state, as the beetle, butterfly, &c. Worms crawl upon their bellies and have no feet, as the earth-worm, slug, snail, &c. The generality of insects have only six feet; but some few, generally called by this name, have a great many, as the wood-louse, centipede, &c. Nearly all insects are oviparous; that is, produced from an egg. These eggs are seldom found singly; they are small in size and do not grow. The eggs of some species are hatched in a few days, while those of others remain during the winter, and the young do not come forth until the season at which the leaves of the plants upon which they feed begin to expand.

The second state of the insect is called the eruca, or larva in systematic language, and is known by various common names. Caterpillars are those larvae which are exposed, and feed upon leaves and plants, as the caterpillar of the common cabbage butterfly. The larvae of beetles usually live in the earth, in the trunks of trees, or in the substance upon which they feed; they are generally of a whitish color, thick and clumsy in form, and are called grubs. The larva of the common cockchafer, and of the nut-beetles, are of this description; while the name of maggots is usually given to the larvae of flies, bees, ants, &c., all of which live in the same confined state as those of beetles. It is in this stage or existence that insects are most voracious, and consequently most destructive to plants. When the larva has attained to its full size, it changes into the pupa or chrysalis state. This is done in different situations, according to the tribes to which they belong. The chrysalis of butterflies are naked, and are either suspended or attached to trees, branches, walls, &c. Those of moths are either concealed in a case like the cocoon of a silk worm, or the caterpillar undergoes its change in the earth. The period in which insects remain in this state varies according to the species; but in most cases they are inactive and torpid.

The imago, or perfect insect, is produced from the chrysalis, and is the only state in which all its parts and members are fully developed. The ap-

pearance and economy of perfect insects, in general, is totally different from those of the larvæ and pupæ, and it is only in its final stage of existence that the species can be ascertained. With the exception of such insects as form the Aptera of Linnaeus, all others are furnished with wings, either four or two in number. Some few exceptions, however, occur to this rule; the female of the glow-worm and of some few moths are apterous, while many beetles (although furnished with hard winged cases) are destitute of real wings.

The duration of insects is extremely variable: the greatest proportion appear to be annual, emerging from the egg and passing through the three stages of their existence within the space of a year. But there are a great number of species, particularly among the beetles, which pass three and even four years in the caterpillar state; and instances are on record of beetles remaining in timber from ten to fifteen years. The greatest proportion of moths are biennial, passing the winter in the chrysalis state and closing their existence in the succeeding summer. The transitory life of the ephemera is proverbial; the perfect insect indeed exists but for a day, and seems born only to continue its species; yet in the larva state it enjoys a life of one, two, or even three years.

All insects, as Macleay observes, may be divided into two groups: 1. *Apterous insects*, having either no metamorphosis, or only that kind of it the tendency of which is confined to the increase of the number of feet: these, as their name implies, are destitute of wings. 2. *True insects*, or those whose metamorphosis has a tendency to give wings to the perfect state or imago state, but never more than six feet.

True insects are again divisible into two primary groups: the first of these are organized for mastication in their perfect state, and the second are organised for suction alone. Each of these divisions, according to the system of Macleay, contains five separate orders, the principal characters of which we shall endeavour to make intelligible in common language.

The Mandibulata, or masticating insects, are furnished with jaws of a horny or membranaceous substance, infinitely diversified in their form and structure. They are divided into the following orders:—

1. *Trichoptera*.—The wings are four, soft, and generally transparent; the upper pair slightly hairy, and the lower folded when at rest. The insects of this order are comparatively few. The caddy, or caddis worm, is the larva of the spring fly (*Phryganea*), and lives in the water, concealed within a tube of its own construction. There are many species in this country, well known, in their perfect state, to all lovers of angling.

2. *Hymenoptera*.—The wings are four, clear and transparent. The tarsus (or outer division of the foot) is composed of five joints, and the body is armed with a sting. The bee, the ant, and the wasp, are familiar examples.

3. *Coleoptera*.—This well defined and most extensive order comprehends all insects known by the name of beetles. They have two wings concealed beneath a pair of hard wing-cases, which meet close together in a straight line down the back. There are many tribes of the insects, which, both in their larva and perfect state, are extensively injurious to man.

4. *Orthoptera*.—The true wings are but two,

very large when expanded, and folded lengthways when at rest. They are covered, either partially or wholly, by two wing-cases of a thin, tough, and rather opaque substance, somewhat resembling parchment, and reticulated with small nerves. The leading characters of this order are exemplified in the blatta, or cock-roach, the pest of tropical countries, and frequently troublesome to our kitchens and larders.

5. *Neuroptera*.—The wings, with very few exceptions, are four in number, clear, transparent, and reticulated with numerous areolets, or irregularly square divisions; the tail of the female is not armed with a sting. Few, if any, of these insects may be considered as injurious: some are, indeed, beneficial: as, from their predatory habits, they attack and devour a vast number of smaller insects. This is more particularly the habit of the green dragon-fly, which every one may see, during summer, hovering over ponds, and flying about like a hawk in search of its prey. The ephemera, or day-flies, likewise belongs to this order; and, although not very numerous in this country, are so abundant on the Continent, that they are collected annually in barrows, and afford to the agriculturist a rich and valuable manure.

The Haustellata, or suctorial insects, likewise contain five orders. Although apparently destitute of jaws, there is every reason to believe, from the observations of the celebrated Savigny, that the rudiments of the masticating organs exist in these insects, but that they are so slightly developed as to be totally useless, and only discoverable under a very strong magnifier. The suctorial insects in their larva state are mostly furnished with strong and well defined jaws, and feed voraciously upon animal and vegetable bodies; yet, from the perfect insect being supported by suction alone, it is obvious that in this state they can do no injury to the agriculturist. The orders into which they have been divided are these:—

1. *Lepidoptera*.—The wings are four, thin, membranaceous, and covered with a fine powdery substance, which, by the magnifying glass, is shown to consist of minute scales, lying one upon another, like those on fishes. The butterfly and moth tribes are familiar to every one, as well known examples of these insects, the larva of which are called caterpillars.

2. *Diptera*.—The wings are two, clear and transparent, like those of the common house-fly. This order is very numerous, and contains many insects which are injurious to vegetables as larvæ, and troublesome to man in a winged state; as the gnat (*Culex*), house-fly (*tabanus*), crane-fly (*tipula*), &c.

3. *Aptera*.—Entomologists of the last century arranged all insects without wings under this order; but it is now restricted, by Latreille and Macleay, to such only as have a bivalve articulated sheath to their mouth or rostrum, and no wings, as in the case of the common flea.

4. *Hemiptera*.—Insects of this order are furnished with two folded wings, covered by wing-cases, also crossing over each other, of a semi-corneous substance, and which are likewise useful as organs of flight. The tarsi are composed of three, two, or sometimes only of one joint, and the body is much flattened. The various insects commonly called field-bugs, which emit a strong and disagreeable smell when handled, are all arranged under this order.

5. *Homoptera*.—These insects have a great resemblance to the last: but the body, instead of being

depressed and flat, is convex and thick; the wings also, instead of being folded over each other, are deflexed, and embrace the sides of the body. There are, comparatively, few homopterous insects in England; but the frog-hopper (*cicada spumaria*, L.) is a good example when in its perfect or winged state. The larva resides in a drop of froth of its own making, and is then commonly known as the cuckoo-spit insect; by feeding upon the sap it causes the leaves to curl up, and the growth of young plants is thus materially checked.

PROTECTION FROM FIRE.

(Resumed from page 320, and concluded.)

In order to show how the head, eyes, and lungs are protected, the fireman put on the asbestos and wire-gauze cap, and the cuirass, and held the shield before his breast. A fire of shavings was then lighted, and kept burning in a large raised chafing-dish; the fireman plunged his head into the middle of the flames with his face to the fuel, and in that position went several times round the chafing-dish for a period longer than a minute. In a subsequent trial, at Paris, a fireman placed his head in the middle of a large brazier filled with flaming hay and wood, as in the figure below, and resisted the action of the fire during 5 or 6 minutes, and even 10 minutes.



In the experiments which were made at Paris in the presence of a committee of the Academy of Sciences, two parallel rows of straw and brush-wood, supported by iron wires, were formed at the distance of three feet from each other, and extended 30 feet in length. When this combustible mass was set on fire, it was necessary to stand at the distance of 8 or 10 yards to avoid the heat. The flames from both the rows seemed to fill up the whole space between them, and rose to the height of 9 or 10 feet. At this moment six firemen, clothed in the incombustible dresses, and marching at a slow pace behind each other, repeatedly passed through the whole length between the two rows of flame, which were constantly fed with additional combustibles. One of the firemen carried on his back a child eight years old, in a wicker-basket covered with metallic gauze, and the child had no other dress than a cap made of amianthine cloth.

In February, 1829, a still more striking experiment was made in the yard of the barracks of St. Gervais. Two towers were erected two stories high, and were surrounded with heaps of inflamed

materials, consisting of faggots and straw. The firemen braved the danger with impunity. In opposition to the advice of M. Aldini, one of them, with the basket and child, rushed into a narrow place, where the flames were raging eight yards high. The violence of the fire was so great that he could not be seen, while a thick black smoke spread around, throwing out a heat which was unsupportable by the spectators. The fireman remained so long invisible that serious doubts were entertained of his safety. He at length, however, issued from the fiery gulf uninjured, and proud of having succeeded in braving so great a danger.

It is a remarkable result of these experiments, that the firemen are able to breathe without difficulty in the middle of the flames. This effect is owing not only to the heat being intercepted by the wire-gauze as it passes to the lungs, in consequence of which its temperature becomes supportable, but also to the singular power which the body possesses of resisting great heats, and of breathing air of high temperatures.

A series of curious experiments were made on this subject by M. Tillet, in France, and by Dr. Fordyce and Sir Charles Blagden, in England. Sir Joseph Banks, Dr. Solander, and Sir Charles Blagden entered a room in which the air had a temperature of 198° Fah., and remained ten minutes; but as the thermometer sunk very rapidly, they resolved to enter the room singly. Dr. Solander went in alone, and found the heat 210°, and Sir Joseph entered when the heat was 211°. Though exposed to such an elevated temperature, their bodies preserved their natural degree of heat. Whenever they breathed upon a thermometer it sunk several degrees: every expiration, particularly if strongly made, gave a pleasant impression of coolness to their nostrils, and their cold breath cooled their fingers whenever it reached them. On touching his side, Sir Charles Blagden found it cold like a corpse, and yet the heat of his body under his tongue was 98°. Hence they concluded that the human body possesses the power of destroying a certain degree of heat when communicated with a certain degree of quickness. This power, however, varies greatly in different media. The same person who experienced no inconvenience from air heated to 211°, could just bear rectified spirits of wine at 130°, cooling oil at 129°, cooling water at 123°, and cooling quicksilver at 117°. A familiar instance of this occurred in the heated room. All the pieces of metal there, even their watch-chains, felt so hot that they could scarcely bear to touch them for a moment, while the air from which the metal had derived all its heat was only unpleasant. MM. Duhamel and Tillet observed, at Rochefoucault in France, that the girls who were accustomed to attend ovens in a bakehouse, were capable of enduring for ten minutes a temperature of 270°.

The same gentlemen who performed the experiments above described ventured to expose themselves to still higher temperatures. Sir Charles Blagden went into a room where the heat was 1° or 2° above 260°, and remained eight minutes in this situation, frequently walking about to all the different parts of the room, but standing still most of the time in the coolest spot, where the heat was above 240°. The air, though very hot, gave no pain, and Sir Charles and all the other gentlemen were of opinion that they could support a much greater heat. During seven minutes Sir C. Blagden's breathing continued perfectly good, but after

that time he felt an oppression in his lungs, with a sense of anxiety, which induced him to leave the room. His pulse was then 144, double its ordinary quickness. In order to prove that there was no mistake respecting the degree of heat indicated by the thermometer, and that the air which they breathed was capable of producing all the well-known effects of such a heat on inanimate matter, they placed some eggs and a beef-steak upon a tin frame near the thermometer, but more distant from the furnace than from the wall of the room. In the space of twenty minutes the eggs were roasted quite hard, and in forty-seven minutes the steak was not only dressed, but almost dry. Another beef steak, similarly placed, was rather overdone in thirty-three minutes. In the evening, when the heat was still more elevated, a third beef-steak was laid in the same place, and as they had noticed that the effect of the hot air was greatly increased by putting it in motion, they blew upon the steak with a pair of bellows, and thus hastened the dressing of it to such a degree, that the greatest portion of it was found to be pretty well done in thirteen minutes.

Our distinguished countryman, the late Sir F. Chantrey, exposed himself to a temperature still higher than any which we have mentioned. The furnace which he employed for drying his moulds was about 11 feet long, 12 feet high, and 12 feet broad. When it was raised to its highest temperature, with the doors closed, the thermometer stood at 350°, and the iron floor was red hot. The workmen often entered it at a temperature of 340°, walking over the iron floor with wooden clogs, which are of course charred on the surface. On one occasion Mr. Chantrey, accompanied by five or six of his friends, entered the furnace, and, after remaining two minutes, they brought out a thermometer which stood at 320°. Some of the party experienced sharp pains in the tips of their ears, and in the septum of the nose, while others felt a pain in their eyes.

CONVEYANCE OF SEEDS ON SHIP-BOARD.

BY J. KILLIS.

NUMEROUS have been the methods employed in the conveyance of plants to and from distant countries. It is quite unnecessary, however, to enter into any lengthened account of these attempts, as they resolve themselves into two kinds;—the one where the plants are meant to be kept in a passive condition; and the other where means are employed to keep them growing during the voyage.

The best method of keeping plants in a state of rest is the one generally employed, and first recommended by Messrs. Loddiges, viz.—the packing them in successive layers of bog-moss, which answers very well for the majority of deciduous trees and shrubs and other plants, when dispatched at the termination of their active season. For the package of cactuses and other succulent plants, Messrs. Loddiges recommend the driest sand, all vegetable matters being injurious.

But by far the greater number of plants require to be kept growing during the voyage; and, prior to the introduction of glazed cases, a large majority of these plants perished from the variations of temperature to which they were subjected,—from being too much or too little watered,—from the spray of the sea, or, when protected from this spray, from

the exclusion of light. Again, if the voyage lasts longer than usual and the water runs short, it is not every one who has the care of plants that will imitate the example of the patriotic M. de Clieux, who, in 1717, took charge of several plants of coffee that were sent to Martinico, and approved himself worthy of the trust. The voyage being long and the weather unfavorable, they all died but one; and the whole ship's company being at length reduced to short allowance of water, this zealous patriot divided his own share between himself and the plant committed to his care, and happily succeeded in carrying it safe to Martinico, where it flourished, and was the parent stock whence the neighbouring islands were supplied.

Our seedsmen are much distressed for a proper method to keep their seeds sound and in a state of vegetation, through long voyages. Complaints are made, that when the seeds arrive in the East Indies, and often in the West Indies, few of them grow, but that most of them are full of insects, or what they term weevily. This seems to proceed from the damp and putrid heat of the hold, or too long confinement in close warm air, which brings these animals to life, which soon begin to prey on the inside of these seeds; and those seeds which are oily turn rancid. The putrid penetrating steam that strikes every one upon opening the hatches of a full loaded ship's hold, after a long voyage, it is this that does the mischief to seeds. This vapor, as the excellent Dr. Hales observes, will soon become fatal to vegetable substances, as well as animals.

When the cavalry of our army in Germany was under the necessity of being supplied with hay from England, the difference was but too manifest between the hay which had been but a month on board and fresh hay that had never been confined in the hold of a ship. Experiments have been made on the best hemp from Russia, and hemp of English growth, by persons belonging to the navy of great credit and honor, and the difference in the strength is amazing; the length of the voyage from Russia, the very close package that is necessary to stow that article on board, raises such a heat as to show evident signs of putrefaction begun, which must weaken the strongest vegetable fibre. To illustrate this further, in an instance of the different manner of packing and stowing seeds for a long voyage, which has lately come to my knowledge, and may be of use, as it not only points out the error, but, in some measure, how to avoid it.

A gentleman going to Bencoulén, in the island of Sumatra, had a mind to furnish himself with an assortment of seeds for a kitchen-garden; these were accordingly packed up in boxes and casks, and stowed with other goods in the hold of the ship. When he arrived at Bencoulén he sowed his seeds, but soon found, to his great mortification, that they were all spoiled, for none of them came up. Convinced that it must be owing to the heat of the ship's hold, and their long confinement in putrid air, and having occasion to return to England, he determined in his next voyage thither to pack them up in such a manner, and to place them so, as to give them as much air as he could, without the danger of exposing them to salt-water; and therefore put the smaller seeds into separate papers, and placed them among some clean straw in a small close net, and hung it up in his cabin; and the larger ones he put into boxes, stowing them where the free air could come at them and blow through them; the effect was, that, as soon as he arrived at

Bencoulen, he sowed them, and in a little time found, to his great satisfaction, that they all grew extremely well. It is well known to our seedsmen that, even here at home, seeds kept in close warehouses and laid up in heaps frequently spoil, unless they are often sifted and exposed to the air. Seeds saved in moist cold summers, as their juices are too watery, and the substance of their kernels not sufficiently hardened to due ripeness, are by no means fit for exportation to warmer climates.

Our acorns, unless ripened by a warm summer, will not keep long in England: those acorns which are brought from America, and arrive early in the year, generally come in good order, owing to their juices being concocted by the heat of their summer; and are not apt to shrivel, when exposed to the sun as ours are. These hints are given to show how necessary it is to take care that the seeds we send should be perfectly ripe and dry.

COPYING SEALS AND PLASTER CASTS BY THE ELECTROTYPE.

HAVING already described the various apparatus for the electrotype, we purpose by the following remarks only to allude to the manipulation requisite to the seals, previous to their immersion in the acid solution, in answer chiefly to recent inquiries upon this subject.—In former times, when the art of writing was an extremely rare accomplishment, a seal was an instrument of great importance: it fulfilled the same purpose at the end of a conveyance or deed that is now accomplished by the written names of the parties; which even now, in reference to the ancient custom, are termed signatures. No business was performed without the seal, no corporation existed without this appendage. The extraordinary seal of Southwick, which required three separate dies to form one impression, is a good instance of the important functions of the seal; for the three parts being in the respective hands of three trustees, it required the concurrence of all, before a perfect impression could be made; and, consequently, before any land or other property under the trust could be disposed of.

Now that seals are nearly valueless, there can be no harm in describing the process for copying them. This is very simple; we first give them the thinnest film of blacklead, with a hard brush. If necessary, this may be aided by cautiously applying the most minute drop of spirits of wine, but it should be avoided if possible; for the wax being soluble in alcohol, the seal is liable to more or less injury. A fine metallic wire is now to be heated over a candle, and the hot end placed in contact with the rim of the seal so that it may adhere. Care must be taken to apply a little plumbago round the point of insertion, that it may be continuous with the wire. It is then ready to be placed in the solution.

After the seal is removed from the wax, it is usual to mount it by soldering it on to a piece of metal, and then to fix it on a turned handle for convenience of using.

Considerable care is required to effect this purpose, the seal must be first cleaned at the back with charcoal and water, and then dried. A little powdered rosin is sprinkled on the back, and the medal is then held in the flame of a spirit-lamp till the rosin begins to smoke, when a stick of soft solder is rubbed over it, and as soon as the solder adheres all over and fills up the hollows it is allowed to cool. The seal is then placed

face downward on a cork, and with a file carefully reduced in thickness till the edge of the copper is apparent all round, but care must be taken to keep the two surfaces quite parallel. If the seal is very thick, the filling with solder may be dispensed with, as the copper in that case may safely itself be filed flat. A piece of metal, either copper or the alloy known as red gun metal (an alloy of copper and tin) is then prepared with a flat surface at one end sufficient to cover the seal, and with a socket at the other, to which a handle of either agate, ivory, ebony or other hard wood may be fixed. The flat part of the handle must be coated with a thin layer of solder, and that, together with the prepared surface of the seal sprinkled with a little rosin, when the two surfaces are placed in accurate contact, and then held in the flame of a spirit-lamp until the solder melts and unites the two, the edge is then to be carefully filed and polished, and the face of the seal cleaned by charcoal and water. In those cases where the device is very deep it will not admit of being reduced perfectly flat, and in that case, the rim is filed to the same extent all around, and an indentation must be cut in the handle corresponding to the elevation at the back of the seal.

The largest seal, as the great seal of England, or the large seals of the bishops, may, in this way, be copied with ease; and the smallest are attended with no more difficulty. The operator must remember, that although he is at perfect liberty to copy the Chancellor's seal of the last reign, yet he would be liable to the utmost penalty of the law if he were to carry on his scientific proceedings upon the great seal of Her present Majesty. A letter received in the morning may be answered the next day, or even the same night, by a letter sealed with an electrotype impression of your friend's seal. If a relievo be required from a sealing-wax relievo, it may be obtained by a double electrotype operation, or by first making a plaster intaglio, and proceeding with that as for plaster generally. Seals may be made either in silver or copper, the processes for which are similar, in all respects, to that described for making electro-medallions.

Copper or silver moulds may be obtained of the utmost perfection, from plaster medallions. If we desire to take a copper mould or intaglio from a plaster relievo, we simply prepare the plaster by tallow, wax, or any other similar substance. We then carefully apply the black lead, and twist round the rim fine wire to connect it with the battery, after which it is ready to be placed in the metallic solution. The copper or silver copy is by these means as perfect as the plaster. When a relievo of a plaster medallion is desired, we may either electrotype the copper mould, obtained as before, or we may make a mould of white wax, having first filled the plaster with water. The wax mould is to be blacklead, and must have a wire attached to it, before it is put into the solution. The compound of bees'-wax and rosin may be used for the same purposes, its application being similar to white wax. The medal produced by any of these means is quite perfect, and the process is an excellent one; for it is neither attended with difficulty, nor does it require much labor, and is performed without the slightest detriment to the original plaster medallion.

The reduced metal, be it silver or copper, for the foregoing objects can be made of any texture that may suit at best. It may be either produced of the greatest flexibility, or of the most extreme hardness. A very hard medal, cameo, or seal, is best obtained

by using a very strong solution, a single battery, and a large positive copper pole. When a thin layer of blacklead is used, the deposited copper will not in the slightest degree be discolored by it, as the plumbago will always be taken into it, leaving none on the prepared plaster. If a very thick layer of black lead is employed the copper will be discolored.

All embossed surfaces may be copied with facility, whether they consist of paper or any other substance. They must be first rendered non-absorbent by oil, varnish, or wax, according to the thickness of the texture; linseed oil perhaps is to be preferred for paper. It must be allowed to dry before the blacklead is applied to make it ready for the solution.

Dies made from paper generally exhibit a slightly dented appearance in the smooth parts, from the little projecting points of the paper having been copied. Doubtless the attention of the commissioners of stamps and taxes has been drawn to the fact, that the stamps can with great ease be copied by the electro-metallurgist; but it must remain with them to consider whether any attention to the subject is requisite.

A hard copper die formed from a sealing-wax impression would in all probability be applicable to the formation of stamped wafers now so much in use.

[The above directions are taken from Mr. Smee's work, entitled "The Elements of Electro-metallurgy," which, although too expensive, is yet strongly to be recommended.]

THE AURORA BOREALIS.

A LUMINOUS meteor, generally appearing in the northern part of the sky, and presenting a light somewhat resembling the dawn or break of day. The appearances which it exhibits and the forms it assumes are so proverbially unsteady, that it is not possible to comprehend them under any general description. Most frequently the phenomenon appears to proceed from a sort of horizontal cloud or haze in the northern part of the sky, rising a few degrees above the horizon, and stretching from the north towards the east and west, so as to form an arc, which in some instances has been observed to extend upwards of 100° . The upper edge of the cloud is whitish and luminous, the lower part often dark or thick, and sometimes the clear sky may be seen between it and the horizon. From the upper part of the cloud streams of light shoot up in columnar forms, reaching sometimes only a few degrees, sometimes to the zenith, or even beyond it. Instances occur in which the whole hemisphere is covered with coruscations; but the brilliancy is greatest, and the light strongest, in the north, near the main body of the meteor. The streamers have in general a tremulous motion, and, when close together, present the appearance of waves or sheets of light following each other in rapid succession. When several columns, issuing from different points, meet at the zenith, a small meteor is formed of greater brilliancy than the separate columns. The phenomenon sometimes continues a few hours, occasionally the whole night, and even for several nights in succession. It generally commences at most two or three hours after sunset, and very rarely in the morning or much after midnight. Auroras have been observed even before the evening twilight has disappeared. In the Shetland Islands, and other countries in high latitudes, the northern lights are

the constant attendants of cold and frosty evenings in winter. They are most frequent in autumn.

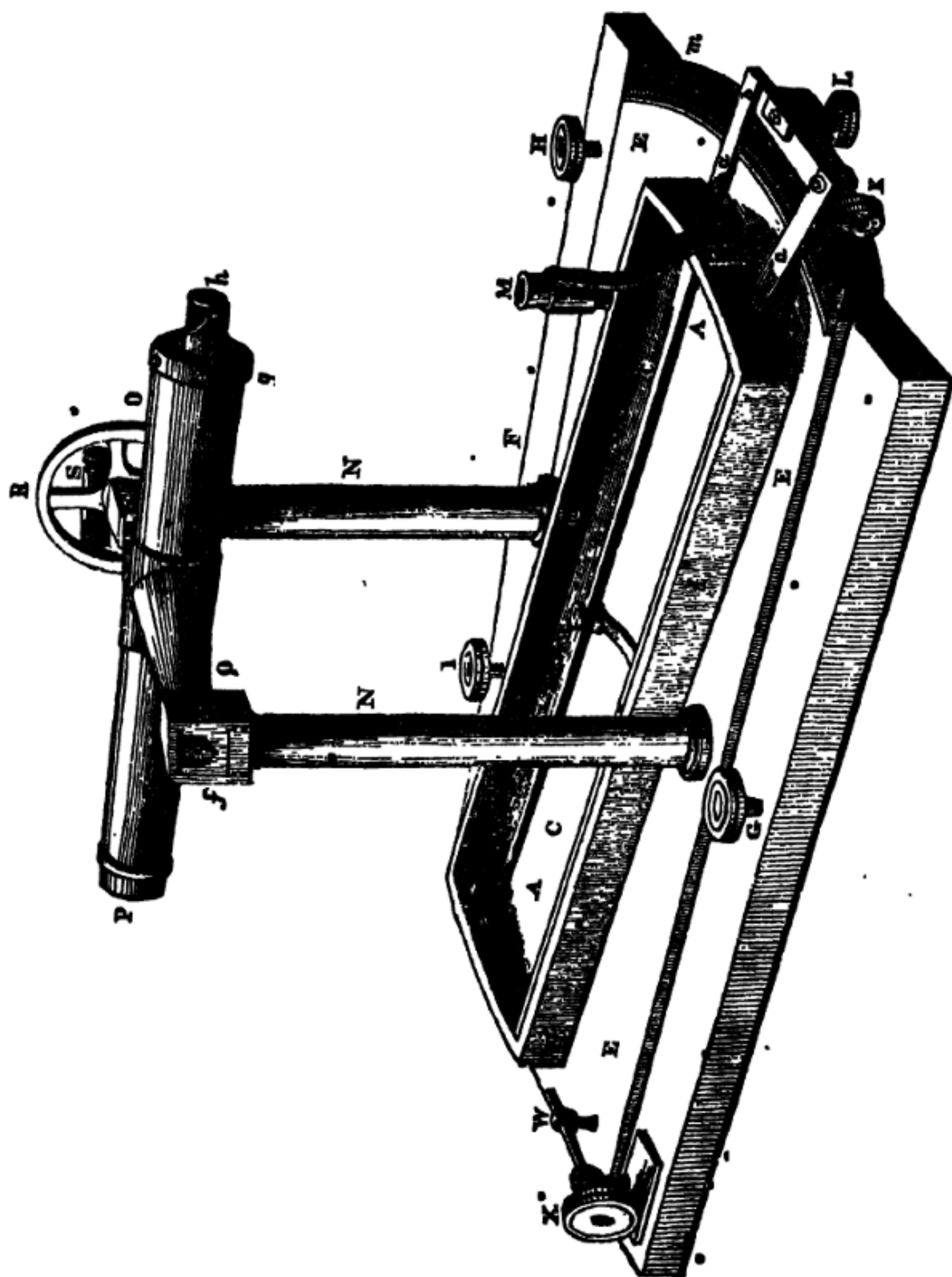
In Captain Franklin's Narrative, the Auroras observed at Fort Enterprise, in North America, are described by Lieut. Wood as follows:—

"They rise with their centres sometimes in the magnetic meridian, and sometimes several degrees to the eastward or westward of it. The number visible seldom exceeds five, and is seldom limited to one. The altitude of the lowest, when first seen, is never less than 4° . As they advance towards the zenith, their centres (or the parts most elevated) preserve a course in the magnetic meridian, or near to it. But the eastern and western extremities vary their respective distances, and the arches become irregularly broad streams in the zenith, each dividing the sky into two unequal parts, but never crossing one another till they separate into parts. These arches which ever bright at the horizon increase their brilliancy in the zenith, and discover the beams of which they are composed, when the interior motion is rapid. This interior motion is a sudden glow, not proceeding from any visible concentration of matter, but bursting out in several parts of the arch, as if an ignition of combustible matter had taken place, and spreading itself rapidly towards each extremity. In this motion the beams are formed. They have two motions; one at right angles to their length, or sideways; and the other a tremulous and short vibration, in which they do not exactly preserve their parallelism to each other. The wreaths, when in the zenith, present the appearance of coronæ boreales. The second motion is always accompanied by colors; for it must be observed, that beams are often formed without any exhibition of colors, and I have not in that case perceived the vibratory motion."

(To be continued.)

ANSWER TO QUERY.

13. *What is the cause of the harvest moon?*—Harvest moon is a remarkable phenomenon relating to the rising of this luminary in the harvest season. During the time she is full, and a few days before and after, in all, about a week, there is less difference in the time of her rising between any two successive nights than when she is full in any other month of the year. By this means she affords an immediate supply of light after sunset, which is very beneficial in gathering in the fruits of the earth; and hence it is, that this lunation has been termed the *harvest moon*. In order to conceive this phenomenon, it must first be considered, that the moon is always opposite to the sun when she is full; that she is full in the signs Pisces and Aries in our harvest months, these being the signs opposite to Virgo and Libra, the signs occupied by the sun about the same season; and because those parts of the ecliptic rise in a shorter space of time than others (as may easily be shown and illustrated by the celestial globe), the moon when she is about her full in harvest, rises with less difference of time, or more immediately after sunset, than when she is full at other seasons of the year. Very nearly the same circumstance occurs in the spring when the sun is in Pisces and Libra, and the moon in the contrary signs, but the spring is a brighter season, and the days are then rapidly lengthening; the spring moon is not so much observed or commented upon.



COLONEL BEAUFOY'S MAGNETIC COMPASS.

COL. BEAUFOY'S MAGNETIC COMPASS.

THE principal part of this instrument, viz. its needle, with the box and divided arc, to measure the angle of variation, is very similar to the instrument in the possession of the Royal Society; but it is greatly improved by the addition of a small transit telescope, which very readily and accurately determines the true meridian, or the zero from which the degree of the variation is to be measured. This addition renders it particularly well adapted for travellers who wish to make accurate observations in different parts of the globe, as it contains every thing necessary for the observation within itself; and as every part admits of adjustment, by reversing, it may be depended upon for accuracy.

The figure given contains a representation of the whole instrument in perspective, explaining all its parts at once. The box containing the needle is not fixed as in many compasses, but turns horizontally on a centre, and has an index fastened to it, pointing to a divided arc, on the brass frame on which it turns; and the method of observing is to move the box till a line drawn on it points exactly to the end of the needle, which being done, the angle of variation is shown by the divisions on the arc. FF is a mahogany board, which is the support of the whole instrument; it stands on the points of three screws, G H I, by which it can be levelled. Above this is a flat plate of brass E E, attached to the board by a centre pin, and resting upon three studs projecting from the board, to ensure its having a perfect bearing, whilst it admits of a small horizontal motion round the centre by means of the screw W X. The plate E E has the divided arc *m* fixed upon one end of it; and a vernier D traverses against the divisions; it is divided upon a projecting part of a brass plate C C, which moves on the common centre pin of the plate E, and also the needle A A B. The plate C C has two segments of brass at each end of the needle, and these have the centre lines drawn upon them, which are brought to the points of the needle when the observation is made. A light brass box *d d*, with a glass cover, is fitted over the plate C C to preserve the needle from disturbance from the wind; it also supports a small double microscope M, intended to assist in examining when the index line points exactly to the end of the needle; the stem of the microscope is fitted in a dovetail groove.

The centre pin of the plates E and C, terminates in an extremely fine point on which the needle is suspended, having an agate cap B, to diminish the friction as much as possible. The needle is of a cylindrical figure, about the five-hundredth of an inch in diameter, and 10 inches long, and weighs 65½ grains, and is terminated by two conical points; the circular enlargement of the centre has a hole through it for the reception of the brass socket B, which has the agate cap fixed in it; the needle is of course provided with the usual apparatus for lifting it off the point when not in use, to avoid wearing the point of suspension. *a a* are two arms screwed down upon the plate, carrying the vernier D; they support a brass frame *b*, which has the usual clamp screw L, and tangent screw R, the former to fasten it to the arc *m*, and the latter to give a slow motion, and adjust the box for the observation.

The transit telescope O P is supported over the instrument by two pillars N N, fixed on the brass plate E E, and having small frames or boxes *f* at the top, for the reception of the Y's, in which the pivots of the axis Q of the telescope are supported;

this axis is conical, and is fixed exactly at right angles to the tube O P.

On the extremity of one of the pivots of the axis, a small divided circle R is fixed, and has an arm at the opposite side, turning about on the centre, and provided with verniers to read the divisions on the circle; to this arm a small level S is attached; the whole forming a flying index to set the telescope at any required altitude, by setting the index at the proper division, and then moving the telescope till the bubble of the level S shows the index to be horizontal; the eye-piece A, of the telescope has a small dovetail in it to admit a dark glass for observation of the sun; *g* are the screws for adjusting the wires in the eye-piece as usual; the separate figure T V is a level to adjust the instrument.

Manner of adjusting the instrument previous to observation.—First place the feet *k l* of the level upon the brass plate E E in different directions, and bring it level by the screws H I K; then apply the level upon the two pivots of the transit, the covers of the boxes *f* opening with hinges for this purpose, and the bottom of the feet *k l* have notches to rest upon the pivots; if the axis does not prove level, one of the Y's must be elevated or depressed, by a screw in the farther pillar N, until the level stands horizontally, and reversing it end for end proves every thing to be correct.

Now set the vernier D at zero, and put an additional object glass over the glass P of the telescope; and in this state the marks near A A, against which the needle reads, can be seen through it when directed to them; this proves the zero of the division to be exactly in the plane of the telescope motion; a small screw near Q will rectify it, if necessary, by moving the Y a small quantity in the box *f*; the transit may be reversed in its Y's to rectify every thing. The telescope is now to be adjusted to the meridian by the transit of the stars in the usual manner the screws W X, being used to turn the whole instrument round when requisite; but after these observations have been once made in a satisfactory manner, distant marks should be set up both north and south, and these will give the means of adjusting it at once, and in the day time.

When the instrument is properly placed, the taking of the observation is extremely simple. The needle being suffered to settle, the box is turned about on its centre till the mark comes very near the point of the needle; the clamp screw L is then fastened, and the screw *k* is employed to make the coincidence exact, in which the microscope M greatly assists the eye. The vernier D now shows the angle of variation. It is proper, after the needle has been once observed, to attract it with a piece of iron, and cause it to make a slight vibration. When it settles again, it will not in all cases come to the same point, because of the friction of the suspending point; it is therefore advisable to make this trial three or four times, and take the mean of the whole.

The instrument is placed on a pillar, in the open air, free from any iron, and is adjusted before every observation; the vernier is divided to half minutes, and if the meridian be not at a considerable distance, an advantage will be gained by diminishing the aperture of the object-glass by a pasteboard cap. "I have found that the needles," says Col. Beaufoy, "should not exceed the weight mentioned 65½ grains: and it may be worth while to remark, that this instrument will serve as a portable transit instrument for naval officers to examine the rate of their chronometers while on shore."

GENERAL MANAGEMENT OF STOVE PLANTS.

THE management of stove plants depends a great deal on the kind of house in which they are grown; but there is little difficulty in growing them well, if the house can be kept up to a proper heat, and a sufficient quantity of air can be given when required. Close glazing is to be preferred; either the lights should be leaded, or the laps stopped with putty; so that a sufficient quantity of air may always be given and the house kept to a more regular heat. When the laps of the glass are left open, a great deal of air is admitted, which is often injurious, particularly on a cold windy night. The thermometer should never be allowed to be below 60° Fah.; if it gets above 70° on a fine day, a little air may be given, which should be taken away early, and the house shut up warm; it then requires less fire to keep up the heat through the night. If the house is heated in the common way by fires, and the plants are plunged in tan, care must be taken not to give these too much bottom heat, as it will injure their roots; or too much water in winter, as it is apt to rot them. Particular caution is necessary for watering in winter not to wet the tan, as it makes the worms very troublesome; they often destroy young plants by throwing the mould out of the pots: but a better way is the one now very generally adopted, viz. to do without plunging in tan. Some hot dung or tan may still be kept in the pit to throw up a little warmth, on which should be put a good thickness of sand or gravel for the pots to stand on, and the plants will thrive much better than when plunged in tan: it is also coming nearer to nature, which should be always studied in the cultivation of plants, both in soil and situation. In tropical countries it is the sun that heats the earth in which the plants grow, not the earth that heats the air; and the heat must be kept up in the stoves accordingly. If the houses are heated by steam, no tan is required. The plants may be set on stages, or any way that is most convenient. Some of them may be planted out in the house, where they will grow in greater perfection, and flower and ripen fruit better than when confined in pots.

To have plants look well, they should be always kept clean and free from insects: if infested with any species of *Aphis* (generally known by the name of green fly), the house should be smoked with tobacco, which instantly destroys them. The red spider is likewise a great pest to cultivators, but are also easily destroyed. One pound of sulphur vivum mixed up in a pail of quick lime, and the flies brushed all over with it as a common whitewash, will destroy any quantity of them, and make the house look light and clean. The mealy bug is also troublesome if left to increase on the plants; but as soon as they appear they should be brushed off, as well as the scaly insects; for, if left to increase, they will disfigure the plants, and be very difficult to get rid of. In fine weather the plants should be often sprinkled over with water from an engine, and the house shut up warm afterwards, which is a great means of keeping them clean and making them grow luxuriantly. Air should be given in the morning as early as possible, in fine weather, as it sweetens the house and makes the plants healthy. It should also be taken away early in the afternoon, and the house shut up warm, that they may not be chilled by the night air.

In potting plants care should be taken to drain

the pots well with broken potsberds, or rough bits of turf; for nothing injures them more than letting them get sodden with too much wet. The best time to shift them in fresh pots is the spring, but some will require to be shifted again in autumn to have them thrive well. The free-growing kinds cannot be well overpotted if there be plenty of room for them in the houses: they will thrive and flower better for being in large pots. Others that are more tender should be kept in as small pots as possible, that they may not get sodden and lose their roots.

For the propagation of plants, a small house should be appropriated: a north-east aspect is preferable to any other, so as to have the morning sun, and none afterwards; then they want no artificial shading; for, the less sun cuttings have before they are rooted, and the more light, the better. A pit might be made in the house, and one part of it filled with fresh tan, another part with rotten tan, and the third part with mould. In the fresh tan might be plunged, under hand-glasses or bell-glasses, any cuttings of plants requiring heat; in the rotten tan, under bell-glasses, any kinds not requiring heat; and in the mould, under hand-glasses, large cuttings of greenhouse plants, &c. which require no heat. Cuttings, particularly of woody plants, root best in fine sand, and are safe to pot off after being rooted, as the sand shakes clean from their roots without injuring them. When planted in mould the roots are apt to break off in parting them; but some of the herbaceous or soft-wooded kinds will not root well in sand, and must therefore be planted in mould. Cuttings must be put in when the wood is fit. Some kinds root freely in either young or ripened wood; other kinds will only strike in very young wood, and others only in ripened wood. From Christmas to April may be considered as good a time as any to put in most kinds of cuttings; as they root more freely before the weather gets too warm: but some kind or other requires to be put in every week throughout the year. No leaves should be taken off any plants except decayed ones; for it weakens them very much. Taking off a large leaf from a young plant will generally kill it; a circumstance that few cultivators are acquainted with.

In procuring loam and peat, &c., for potting, the nearer the surface it is got the better; and fresh soil is always preferable to that which has been laid together a considerable time to rot. Where peat cannot be readily procured, decayed leaves or wood, mixed with a considerable quantity of sand, will answer very well for some plants, and light sandy loam for others. The lighter and more sandy loam is, the less quantity of peat it requires to have mixed with it.

When seeds are received from abroad, some of them should be sown immediately, whatever season it may be; for sometimes seeds will grow when first received, which will not if kept some months longer: but the general time of sowing should be early in spring, that the plants may get strong before winter. A gentle hot-bed is best for bringing up most of the tropical kinds, but some few will come up better on a shelf, or a fire of the hot-house. The sooner seedlings are potted off the better, as they do not miss their moving when potted off very young; but seedlings are not so hardy, nor so easily preserved, as plants raised from cuttings, and seldom make so good plants; from cuttings they have stronger roots and a greater quantity of them. It is a very erroneous opinion, that is entertained by some people,

to think a plant can be only preserved a certain number of years by cuttings; for a plant that is naturally annual may be preserved several years by continually raising it from cuttings, and keeping it from seeding. Cuttings also taken from a plant that has been dead at the root a considerable time will often strike root sooner, and grow more freely than others taken off a healthy plant. Plants raised from cuttings taken from flowering plants will flower quite young, which cannot be expected from a seedling. When plants cannot be easily raised by cuttings or layers, they should be budded or inarched on some species that is the nearest related to them, and this practice will generally succeed.

TELLING THE CONSTELLATIONS.

To learn to know the heavens, you must first provide yourself with some good celestial charts, or a planisphere of such a size, that stars of the first and second magnitude can be easily distinguished. Having placed



before you one of the charts, that containing the north pole, turn your face towards the north, and first find out the great bear, commonly called Charles's wain. It may be easily known, as it forms one of the most remarkable groups in the heavens, consisting of seven stars of the second magnitude, four of which are arranged in such a manner as to represent an irregular square, and the other three a prolongation in the form of a very obtuse scalene triangle. Besides, by examining the figure of these seven stars, as exhibited in the chart, you will easily distinguish those in the heavens which correspond to them. When you have made yourself acquainted with these seven principal stars, examine on the chart the configuration of the neighbouring ones, which belong to the Great Bear; and you will then learn to distinguish the other less considerable stars which compose that constellation.

After knowing the Great Bear, you may easily proceed to the Little Bear; for nothing will be necessary but to draw a straight line through two anterior stars of the square of the Great Bear, or the two farthest distant from the tail, and which are called the *pointers*; this line will pass very near the polar star, a star of the second magnitude, and the only one of that size in a pretty large space. At a little distance from it, there are two other stars of the second and third magnitude, which, with four more of a less size, form a figure, somewhat similar to that of the Great Bear; but smaller. This is what is called the Little Bear; and you may learn, in the same manner as before, to distinguish the stars which compose it. Now, if a straight line be drawn through these stars of the Great Bear nearest to the tail, and through the polar star, it will conduct you to a very remarkable group of five stars, arranged nearly in this form Δ ; these are the constellations of Cassiopeia, in which a very brilliant new star

appeared in 1572; though soon after it became fainter, and at length disappeared. If a line, perpendicular to the above line be next drawn through this constellation, it will conduct on the one side to a very beautiful star Algenib, which is in the back of Perseus; and on the other, to the constellation of the Swan, remarkable by a star of the first magnitude. Near Perseus is the brilliant star of the Goat, called Capella, which is of the first magnitude, and forms part of the constellation of Auriga.

After this, if a straight line be drawn through the two last stars of the tail of the Great Bear, you will come to the neighbourhood of Arcturus, one of the most brilliant stars in the heavens, which forms part of the constellation of Bootes. In this manner you may successively employ the knowledge you have obtained of the stars of one constellation, to enable you to find out the neighbouring ones. We shall not enlarge further on this method; for it may be easily conceived, that we cannot proceed in this manner through the whole heavens; but any person of ingenuity, in the course of a few nights, may learn by these means to know a great part of the heavens; or at any rate the principal stars. The ancients were not acquainted with, or rather did not insert into their catalogue more than 1022 fixed stars, which they divided into 48 constellations; but their number is much greater, even if we confine ourselves to those which can be distinguished by the naked eye. The Abbé de la Caille observed 1492 in the small space comprehended between the tropic of Capricorn and the south pole; a part of which he formed into new constellations. But this space is to the whole sphere as 3 to 10 nearly; so that perhaps the whole number of the stars visible to the naked eye may be estimated at about 5000. This number does not invalidate the remark commonly made, that we cannot see more than 1000 stars of a clear night, with the naked eye at one time. For the number 5000 refers to the whole stars seen from all parts of the earth on the most favorable nights, and with the clearest eye-sight; whereas a person on land cannot often see at once above $\frac{1}{3}$ of the whole heavens, owing to obscurity and objects in the horizon, &c.

It is a mere allusion that makes us conclude, on the first view, that they are innumerable; for if you take a space comprehended between four, five, or six stars of the second and third magnitude, and try to count those it contains, you will find that it can be done without much difficulty; and some idea may be thence formed of their total number, which will not much exceed that above stated. The stars are divided into different classes, viz., stars of the first, second, third, &c. magnitude, as far as the sixth, which are the smallest perceptible to the naked eye. There are 20 of the first magnitude, 76 of the second, 223 of the third, 512 of the fourth, &c.

THE ORGAN.

(Resumed from page 298.)

BEFORE proceeding to those parts of the organ yet to be described, it may be as well to recur for a moment to the wind chest, and that merely to remark upon the size of various channels into which it is divided. In the arrangement of the pipes afterwards described, we shall find it necessary to state that the larger pipes are invariably arranged at the two ends of the instrument; and as far as such an arrangement is compatible with placing all the pipes

over their respective channels it must be done. Yet we are not to infer that the channels on the right hand side of the instrument are to open into large pipes. This would not be convenient, because the keys belonging to those right-hand pipes are to the left-hand of the key board, and therefore it is most convenient to consider that the various channels along the wind-chest are to agree with, or rather to be appointed to the notes indicated by the keys from bass to treble. Thus if the left-hand channel be double D, the left-hand key will be double D also. When, however, there are any notes below the limit of the key board, they are to be played by treadles worked by the feet, and these being totally distinct from the key frame, and with a separate action, altogether may be placed on the left-hand side, and have the channels on that side.

We have intended the above remark only to apply to the figures we have given in page 297, where the leaders to the valves are seen to diverge from the keys; but we shall have occasion to notice hereafter a superior mode of connecting the keys with the valves, so that we shall be fully enabled to draw down a valve at one end of the board by a key at the other; and thus we are at liberty to arrange the pipes exactly as we please.

It may appear that this remark would have been better timed, when describing the placing of the pipes, but we have made it here, because of the different sizes required for the channels, and therefore that an amateur trying to build an organ may be enabled to contemplate beforehand the difficulties to be overcome. The width of the various channels should be somewhat accordant with the size of the pipes which belong to them. The whole width of the wind-chest, as we have before explained, about 5 feet 3 inches, and the keys 4 octaves (Misprinted 5 in the last paper) These with their flats and sharps will be 48 in number. Taking off the thickness of the ends of the wind-chest, and of its 47 divisions, and which may be of $\frac{1}{4}$ of inch stuff, the aggregate of the 48 channels is reduced to about four feet, or an inch for each channel. In order that we may have no waste of wind for the smaller pipes, and no deficiency of it for the larger, we had better make these channels, of three sizes, $\frac{3}{4}$ inch, 1 inch, and $1\frac{1}{4}$ inch.

We have now to consider the bottom portion of the wind-chest where the valves are situated. The length of this is to be precisely that of the wind chest, and it may be made with four sides, 2 inches deep, made of inch stuff, and a bottom $\frac{1}{2}$ an inch thick; the whole to be of sufficient width to contain the one or two sets of valves afterwards spoken of. Before we put the two parts of the wind chest together, or even before we fix the bottom on the lower part of the wind chest, much remains to be done relative to the valves. These are seen at G G, in both cuts, page 297; in the upper cut the front is seen, in the under the side of two valves; that on the right-hand side in fig. 2 alone appertaining to the keyboard, the other valve belonging to another set of wires connected to the keys, which are worked by means of a barrel, as we shall afterwards explain. If therefore the organ be intended to play only with finger keys, or only with a barrel, one set of valves alone is necessary; if for keys they may be near the back, if for a barrel near the front of the box or wind chest. The lower box or trough is called the valve box, and is about 6 inches from back to front internally, the valves themselves being each 5 inches long, from $\frac{3}{4}$ to $1\frac{1}{4}$ an inch wide, and made from very clean dry

slips of oak, planed quite smooth and chamfered off below. These valves cover holes of the following size, 4 inches long, from $\frac{3}{4}$ to $1\frac{1}{4}$ an inch wide, according to the size of the channels. These holes are the only communication between the channels and the valve box. They may be made thus:—Take two or three pieces of smooth Bristol board or thin wood; as for example, a smoothed veneer; cut these pieces 8 inches wide, and lay them in length across the channels of the wind chest, so that the end of one piece shall join the end of another exactly over the centre of one of the divisions or cross pieces. Now mark with a pencil the centre of each channel, and draw two lines, one on each side of this mark, about $\frac{1}{4}$ or rather more than that from it, according to the size of the channels. Then draw two straight lines from end to end of the pasteboard or veneer, each 2 inches from the centre of it. The pencil lines have now formed a number of squares, or rather oblongs, which being cut through with a sharp pointed pen-knife, form of course so many holes. These are the holes to be covered with the valves: and as it is evident that the opening of one valve is only to admit wind to its own channel, great care is requisite to glue this pasteboard down perfectly air tight. It may be put so as to go over the back edge of the wind chest; this being turned channels upwards for the purpose to fasten it on, procure some hot strong glue,* and a hot flat iron. Take one piece of the pasteboard or veneer, place it ready to be fastened down, glue all over its underside, and also over the division boards upon which it is to sit; put it in its proper place, then with the flat iron, moderately heated, iron over the piece fastened down, which will, if well managed, render that portion of the work complete; the other pieces are to be glued down in the same manner, and the whole left to dry. If it should be seen that the edges are not air tight, or that any part bulges out, little slips glued and brad-ded over the divisions will render it tight. Next prepare the valves as follows:—paste or glue a piece of wash leather on the upper or wider surface of each valve, and let it project an inch at one end; in other respects cut it all the way round even with the wood, this is best done when it has had time to dry. Drive in then on the under surface at $\frac{1}{2}$ an inch from the end a small wire staple or ring. Arrange the valves in their proper places according to their sizes; put a slip of wood along the wind chest as a temporary guide to keep them straight; finally glue them down by the loose end of the leather which has been left for that purpose. See next if the frame already made of the valve box will fit over them easily, so as to allow them also to play up and down without impediment. The valves which are the most important part of all will now be complete.

The next to be considered are the springs to keep the valves to their work and the wires to open them with. The wires for the latter purpose should be of steel, or hardened brass, about the size of small bell wires, cut with a screw thread at one end, and turned with a small close hook at the other. The hook is attached to the little staple at the bottom of the valve, and the lower end of it fastens to levers connected with the keys as is shown at S S, Figs. 1 and 2, p. 297. As the consideration of these will occupy some space, we are obliged to defer the subject till another opportunity.

(To be continued.)

CLEANING FEATHERS FROM THEIR OIL.

TAKE for every gallon of clean water, one pound of quick-lime, mix them well together, and when the undissolved lime is precipitated in fine powder, pour off the clear lime-water for use at the time it is wanted. Put the feathers to be cleaned into another tub, and add to them a quantity of the clear lime-water, sufficient to cover the feathers about three inches when well immersed and stirred about therein. The feathers when thoroughly moistened will sink down, and should remain in the lime-water three or four days, after which, the foul liquor should be separated from the feathers, by laying them on a sieve to drain. The feathers should be afterwards well washed in clean water and dried upon nets, the meshes of which should be about the fineness of those of cabbage-nets. The feathers must, from time to time, be shaken upon the nets: and as they dry, they will fall through the meshes, and are to be collected, in order to be beaten as usual for use. The admission of air will be serviceable in the drying, and the whole process will be completed in about three weeks.

THE AURORA BOREALIS.

(Resumed from page 323, and concluded.)

THE northern lights are sometimes seen tinged with the various prismatic colors, among which orange and green, but more frequently the different shades of red, predominate. Maupertius describes one seen by him in Lapland, by which an extensive region of the heavens toward the south appeared tinged of so lively a red that the whole constellation of Orion seemed as if dyed in blood. Some observers of this meteor have affirmed that they have heard a rustling or crackling sound proceed from it. Doubts have, however, been entertained on this point, from the circumstance that no such noises were heard by Scoresby, Richardson, Franklin, Parry, and Hood, who observed the polar lights with great care, under the most favorable circumstances, in very high latitudes. But the testimony of other observers is of so positive a kind as to leave no reasonable doubt that the phenomenon has, at least in particular instances, been accompanied by sounds.

From the accounts which have been collected of the polar lights, it would seem that the phenomenon was less frequent in former ages than it is now; but it must be kept in mind that meteoric observations have not always been so much attended to as at present. Aristotle describes the phenomenon with sufficient accuracy in his book of *Meteors*. Allusions are also made to it by Pliny, Cicero, and Seneca; so that it must have been often witnessed by the ancients, even in the climates of Greece and Italy. The descriptions of armies fighting in the air, and similar prodigies observed in the dark ages, doubtless owed their origin to the striking and fantastic appearances of the northern lights. It is remarkable, however, that no mention is made by any English writer of an Aurora Borealis having been observed in England from the year 1621 to 1707. Celsius says expressly that the oldest inhabitants of Upsala considered the phenomenon a great rarity before 1716. In the month of March in that year a very splendid one appeared in England, and by reason of its brilliancy attracted universal attention. It has been described by Dr. Hally in the *Phil. Trans.*, No. 347. Since then the meteor has been much more common.

The Aurora is not confined to the northern hemisphere, similar appearances being observed in high southern latitudes. An Aurora was witnessed by Don Antonio d'Ulloa at Cape Horn in 1745; one appeared at Cusco in 1744; and another is described by Mr. Forster (who accompanied Captain Cook in his last voyage round the world), which was seen by him in 1773, in latitude 58° south, and resembled, entirely, those of the northern hemisphere, excepting that the light exhibited no tints, but was of a clear white. Similar testimony is given by subsequent navigators.

There is great difficulty in determining the exact height of the Aurora Borealis above the earth, and accordingly the opinions given on this subject by different observers are widely discordant. Mairan supposed the mean height to be 175 French leagues. Bergman says 460 miles, and Euler several thousand miles. From the comparison of a number of observations of an Aurora that appeared in March 1826, made at different places in the north of England and south of Scotland, Dr. Dalton, in a paper presented to the Royal Society, computed its height to be about 100 miles. But a calculation of this sort, in which it is of necessity supposed that the meteor is seen in exactly the same place by the different observers, is subject to very great uncertainty. The observations of Dr. Richardson, Franklin, Hood, Parry, and others seem to prove that the place of the Aurora is far within the limits of the atmosphere, and scarcely above the region of the clouds; in fact, as the diurnal rotation of the earth produces no change in its apparent position, it must necessarily partake of that motion, and consequently be regarded as an atmospherical phenomenon.

No satisfactory theory has yet been given of the cause of the polar lights. Mairan ascribed the phenomenon to the sun's atmosphere; Euler, to particles of the earth's atmosphere driven beyond its limits by the impulse of solar light. Beccaria, Canton, Franklin, and others refer it to electricity, an agent to whose mysterious influence all the inexplicable phenomena of meteorology are conveniently ascribed. An absurd theory proposed by M. Libes (*Dictionnaire de Physique*) formerly met with considerable favor. He had observed that on passing an electric spark through a compound of oxygen and nitrogen, nitrous vapors of a reddish color are produced. He therefore supposed that the higher regions of the atmosphere near the pole contain little or no hydrogen; and that consequently the discharges of electricity, which, by producing a combination of oxygen and hydrogen, form water in the lower strata, in the more elevated strata produce nitrous vapors, which constitute the polar lights. That some connexion subsists between the Aurora and magnetism, or rather electricity, which is now regarded as the primary cause of magnetism, is made certain by the fact that during the continuance of brilliant Auroras the magnetic needle is generally disturbed, sometimes violently agitated. The air at the same time is often observed to be highly charged with electric matter. An experiment contrived by M. Canton also seems to indicate an electric origin. If a glass tube be partially exhausted of air, hermetically sealed, and applied to the conductor of an electric machine, the whole tube is illuminated from end to end, and continues luminous for a considerable time after it has been removed from the conductor. If, after this, the tube be drawn through the hand, the light will be remarkably intense through its whole length; and if it

is grasped in both hands, near the extremities, strong flashes of light will dart from one end to the other, and continue many hours without fresh excitation. The only conclusion which, in the present state of our knowledge, we are warranted in deducing, is, that the Aurora Borealis must be ascribed to the agency of electricity in the upper regions of the atmosphere: in what way the excitement is produced, it remains for future discoveries to make known.

The most systematic series of observations which we possess on the subject was made by the Rev. James Farquharson, of Aberdeenshire, in 1829, with an apparatus furnished by the Royal Society, and of which an account is published in the Transactions for 1830.

THE DIVINING ROD.

In the article which Montucla has given under this head, he expresses strongly his opinion that the performances which are said to have been effected by the aid of the divining rod, are either illusions or philosophical quackeries. The rod itself is merely a forked hazel twig, and it is said that, if held by the tips between the fingers and thumb, there are certain persons in whose hands it spontaneously revolves with considerable force, when near or over either a spring of water or treasure concealed in the earth; and it is said to have been available in discovering criminals.

Montucla mentions a person named d'Aymar, who by the aid of the divining rod, pointed out a murderer, of whom he had been sent in pursuit, among many other persons whom he found in prison with him. But the belief among the better informed people of the time was, that d'Aymar had accidentally been a witness of the murder; and gave credit to his rod for the knowledge which he had derived from a more feasible source. He was a treasure-finder too; but having failed most egregiously in an experiment where he had to experiment only, he was thenceforth accounted a cheat, and died in poverty. Peranque, another of these impostors, exercised his vocation in the southern provinces of France. The wonder in him was his powers of vision. He could see springs in the bowels of the earth, even at great depths; and he could trace out their course and give a good estimate of their depth. Another worthy of the same district, discovered secret springs, by a faculty which manifested itself in a less agreeable manner; he was seized with violent illness when he passed over the place where they were.

A female at Lisbon had the sharp-sighted faculty of divination. When but a child she discovered (and it is said truly) that the family cook was encephalic, by seeing the child in its mother's belly. The human body was to her sight transparent. She was even able to point out to the physicians the viscera affected with disease; but it was essential to the exercise of her faculty, that the body should be exposed to her view—naked. It is pretended that many wells at Lisbon were dug in consequence of her indications; and that she discovered by her sight an obelisk which had been long buried in the earth, and which was dug out and erected as an ornament to the city. It is not to be wondered at, that in these times of general credulity, when the little scientific knowledge possessed by the learned was often employed for the purposes of delusion, such follies obtained a certain degree of credence; but it is lamentable to reflect

that, even among the most enlightened classes, many were believers in the powers of the divining rod.

Soon after the publication of the first edition of the English translation of Montucla, Dr. Charles Hutton, the translator and editor, received a clever anonymous letter from a lady, declaring that, incredible as it might seem to the Doctor, and unaccountable as it was to herself, she did actually possess the power of discovering hidden springs by the aid of the divining rod; that she had known several others who had the property; and detailing very fully the circumstances connected with her becoming aware of possessing such a faculty. She pointed out to the Doctor how he might address a letter to her, and a correspondence ensued, from which it eventually appeared that there was no hoax whatever on the part of the lady, who was a person of exalted rank and superior talents. On her coming to town with her family, the Doctor waited upon her to pay his respects, when it was arranged that she should visit him at his residence, and give ocular proof of the power of the divining rod in her hands.

We give the result in Dr. Hutton's own words.

"Accordingly, at the time appointed, the lady with all her family, arrived at my house at Woolwich Common; when, after preparing the rods, &c., they walked out to the grounds, accompanied by the individuals of my own family and some friends; when Lady — showed the experiment several times in different places, holding the rods, &c. in the manner she had described in her letter. In the places where I had good reason to know that no water was to be found, the rod was always quiescent; but in the other places where I knew there was water below the surface, the rods turned round slowly and regularly till the twigs twisted themselves off below her fingers, which were considerably indented by forcibly holding the rods between them. All the company present stood close round the lady, with all eyes intently fixed on her hands and the rods, to watch if any particular motion might be made by the fingers: but in vain; nothing of the kind was perceived, and all the company could observe no cause or reason why the rods should move in the manner they were seen to do. After the experiments were ended, every one of the company tried the rods in the same manner as they saw the lady had done, but without the least motion from any of them." The Doctor adds: "In my family among ourselves, we have since then several times tried if we could possibly cause the rod to turn, by means of any trick in twisting of the fingers, held in the manner the lady did, but in vain; we had no power to accomplish it;" and he expresses his conviction "that there appears to exist such evidences of the reality of the motion, as it seems next to impossible to be questioned."

FRENCH METHOD OF RENDERING LINEN, &c. WATERPROOF.

To 100 lbs. of the best linseed oil are added 1½ lb. of acetate of lead, 1½ lb. of calcined umber, 1½ lb. of white lead, and 1½ lb. of very finely-powdered pumice-stone. These solid substances well ground and mixed together, must be boiled in the oil for ten hours over a moderate fire to prevent the oil from burning. This varnish should be of such a consistence, that, when mixed with a third part of its weight of pipe-clay, it should be as thick as treacle. It is left to settle eight days, and is then to be passed through a lawn sieve. They then grind

In a solution of strong and clear glue, as much pipe clay as amounts in weight to the tenth part of the oil employed, and mix to the consistence of ointment; adding the varnish by degrees, and stirring it well with a wooden spatula. This varnish must be repeatedly stirred till it becomes perfectly fluid, and then the desired tint is given by adding a fourth part of the color ground in oil. The linen must be stretched upon a wooden frame, and the composition applied upon it, with a large spatula 3 inches broad and 9 inches long. The frame is then inverted, and the operation repeated upon the other side of the cloth: it is then left to dry for a week, and separated from the frame for use. This cloth may be used for riding-hoods, covers for carriages, &c.

For leather and skins the same composition is used, but to give the surface a smooth and brilliant appearance, the following varnish is employed:—viz. 5 lb. of the oil varnish, and an equal weight of well-clarified resin are boiled together until the resin is dissolved; they then add 2 lb. of oil of turpentine, having the color to be given to the varnish ground with it, and passed through a lawn sieve: this is to be applied with a brush. When the varnish is thoroughly dry, it must be rubbed even with a pumice-stone and water, and be then washed clean. Two or three coats of varnish being then applied, and each coat suffered to dry for two or three days, is sufficient to produce a brilliancy equal to that of the Japan lacker.

GRINDING AND POLISHING OF CUTLERY

THE various processes which come under this denomination are performed by machinery, moving in general by the power of the steam-engine or water-wheel. Grinding wheels or grinding mills are divided into a number of separate rooms; every room contains six places called troughs; each trough consists of a convenience for running a grindstone and a polisher at the same time, which is generally occupied by a man and a boy.

The business of the grinder is generally divided into three stages, viz. grinding, glazing and polishing. The grinding is performed upon stones of various qualities and sizes, depending on the articles to be ground. Those exposing much flat surface, such as saws, fenders, &c., require stones of great diameter; while razors, whose surface is concave, require to be ground upon stones of very small dimensions. Those articles which require a certain temper, which is the case with most cutting instruments, are mostly ground on a wet stone; for which purpose the stone hangs within the iron trough, filled with water to such a height that its surface may just touch the face of the stone.

Glazing is a process following that of grinding: it consists in giving that degree of lustre and smoothness to an article which can be effected by means of emery of the various degrees of fineness. The tool on which the glazing is performed is termed a glazer. It consists of a circular piece of wood, formed of a number of pieces in such a manner that its edge or face may always present the endway of the wood. Were it made otherwise, the contraction of the parts would destroy its circular figure. It is fixed upon an iron axis similar to that of the stone. Some glazers are covered on the face with leather, others with metal, consisting of an alloy of lead and tin;

the latter are termed caps. In others, the wooden surface above is made use of. Some of the leather-faced glazers, such as are used for forks, table knives, edge tools, and all the coarser polished articles, are first coated with a solution of glue, and then covered with emery. The surfaces of the others are prepared for use by first turning the face very true, then filling it with small notches by means of a sharp-ended hammer, and lastly filling up the interstices with a compound of tallow and emery. The pulley of the glazer is so much less than that of the stone, that its velocity is more than double, having in general a surface speed of 1500 feet in a second.

The process of polishing consists in giving the most perfect polish to the different articles. Nothing is subjected to this operation but what is made of cast steel, and has been previously hardened, and tempered. The polisher consists of a circular piece of wood covered with buff leather, the surface of which is covered from time to time while in use with the crocus of iron, called also colcothar of vitriol. The polisher requires to run at a speed much short of that of the stone or the glazer. Whatever may be its diameter, the surface must not move at a rate exceeding 70 or 80 feet in a second.

TO ESTABLISH AN APIARY.

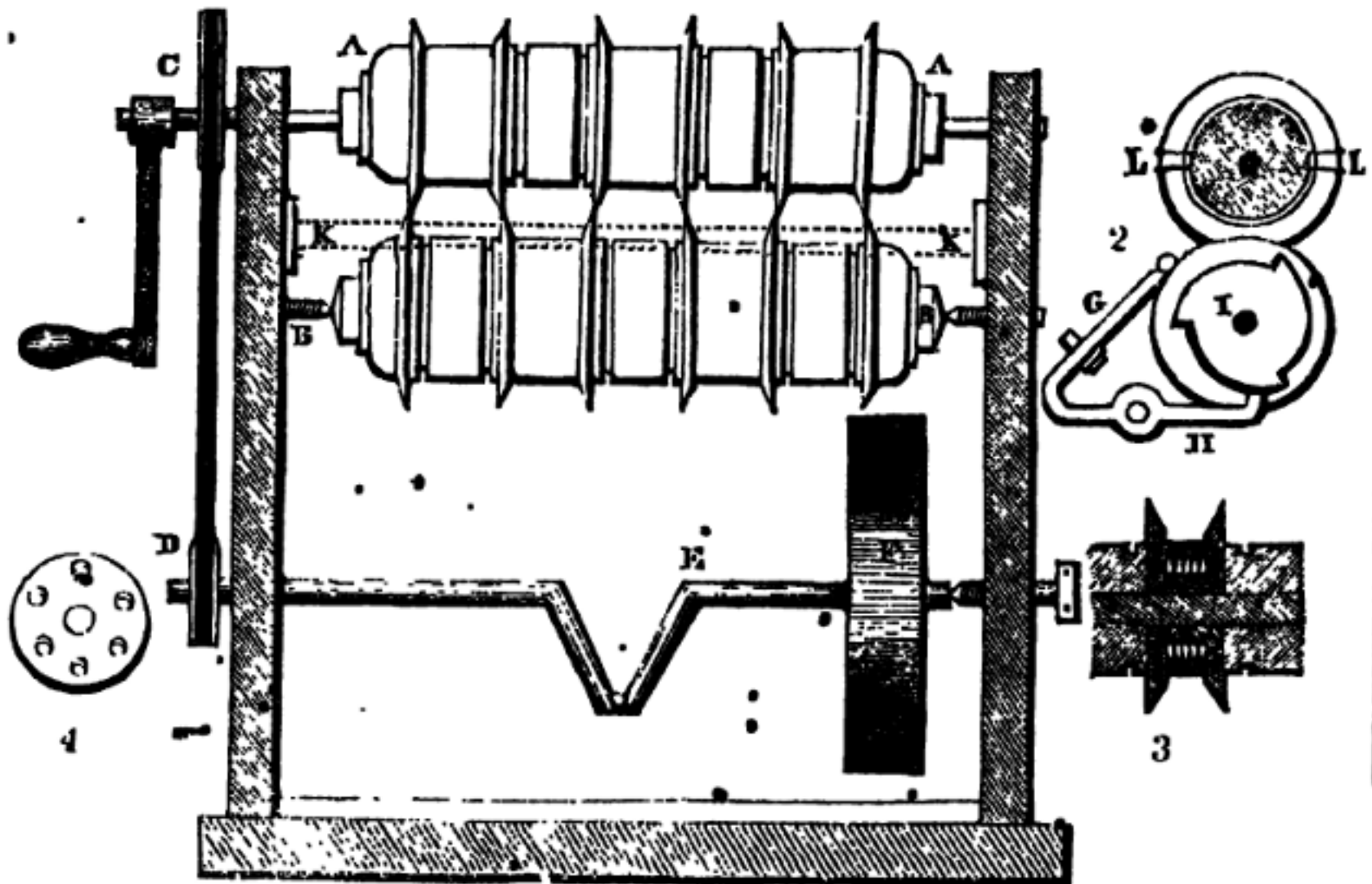
THE best time to establish an apiary is about February, as the stocks have passed through the winter in safety—the combs are then empty of brood, light of honey, and the removal safe and easy. Stocks should be selected by a competent judge, as the weight alone cannot always be relied on; but such as weigh 12 lbs. and upwards—the number of bees must also be observed, and that they are well combed to near the bottom—these may be safely chosen. When they are brought home, set them in the bee-house, being particularly careful to keep them dry. The next day, plaster the hive to the board, leaving an entrance the size of the little finger. If this season has passed, purchase the first and early swarms; for late ones or casts are not worth keeping, unless two or three have been united.

To remove stocks, the evening is the best time; the hive should be raised by wedges some hours previous, unless the floor be also moveable with the hive—otherwise, many bees will remain on the floor at the time, and prove very troublesome. But when the floor is moveable, plaster the hive with mortar to the board; pin a card pierced with holes before the entrance, securing the hive to the board firmly; in this way it would travel any distance. Swarms purchased should be brought home the same evening; for if delayed for a day or two, combs will be worked, and subject to be broken in removing.

TO MAKE FLOUR PASTE.

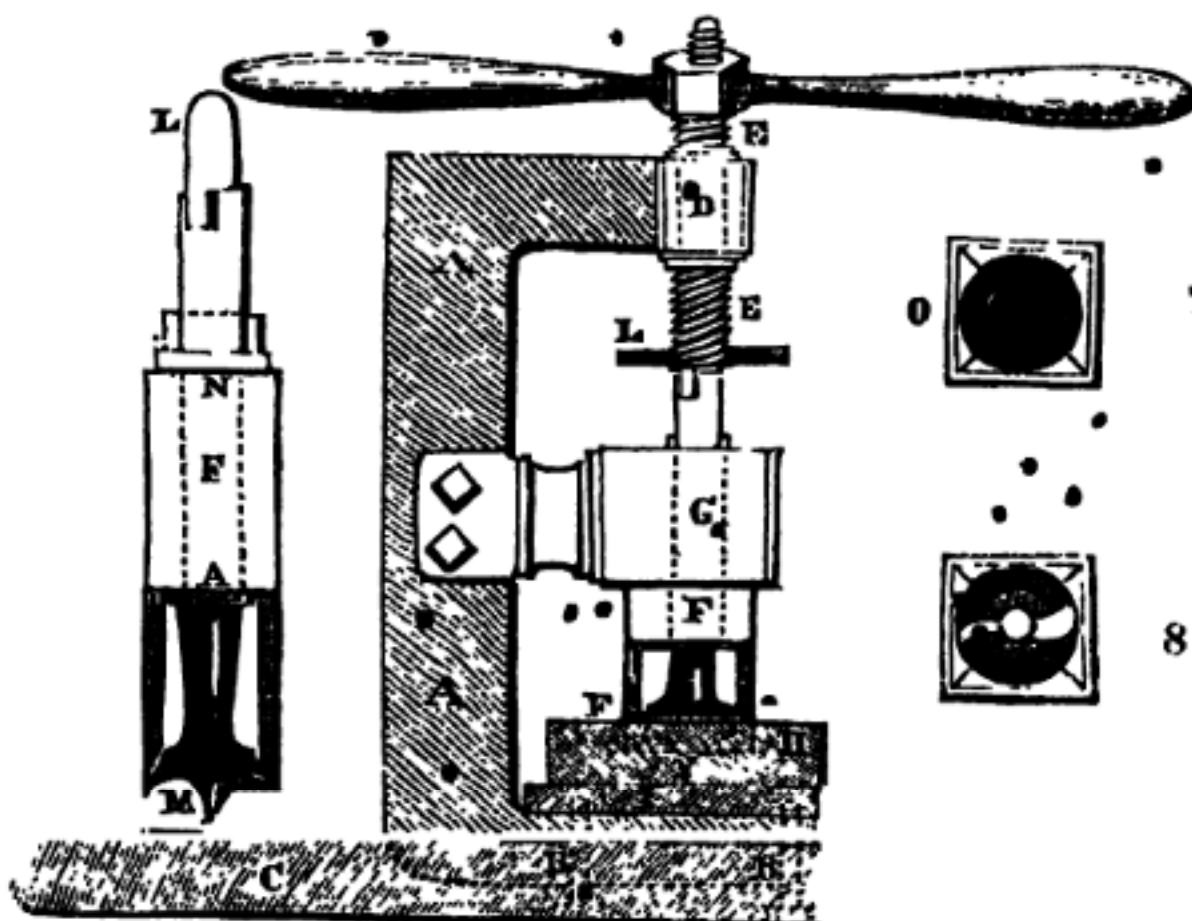
PASTE is formed principally of wheaten flour, boiled in water till it be of a glutinous or viscid consistence. It may be prepared with those ingredients simply for common purposes; but when it is used by bookbinders, or for paper hangings to rooms, it is usual to mix a fourth, fifth, or sixth of the weight of the flour of powdered resin; and where it is wanted still more tenacious, gum arabic, or any kind of size, may be added.

Fig. 1.



MACHINE FOR CUTTING CARDS.

Fig. 5.



AUGER FOR MAKING SQUARE HOLES.

MAKING AND CUTTING OF PLAYING CARDS.

MR. DE LA RUE obtained, in February, 1832, a patent for certain improvements in the manufacture of playing cards, which he distributed under three heads. First, printing the pips, and also the picture or court cards, in oil colors, by means of types or blocks; secondly, effecting the same in oil colors by means of lithography; and thirdly, gilding or silvering borders, and other parts of the characters, by the printing process, either by types, blocks, or lithography. In the ordinary mode of manufacturing playing cards, their devices are partly produced by copper-plate printing, and they are filled up with water colors by the means called stencilling. The patentee does not propose any material alteration in the devices or forms upon the cards, but only to produce them with oil colors; and to effect this he follows precisely the same mode as that practised by calico printers. A set of blocks or types properly devised are produced for printing the different pips of hearts, diamonds, spades, and clubs, or they are drawn, as other subjects, in the usual way upon stone. The ink or color, whether black or red, is to be prepared from the best French lamp-black, or the best Chinese vermillion ground in oil, and laid on the types and blocks, or on the stone, in the same way as printer's ink, and the impressions taken on to thick drawing paper, by means of a suitable press in the ordinary manner of printing.

The picture or court cards are to be produced by a series of impressions in different colors, fitting into each other exactly in the same way as in printing paper hangings, or silks and calicoes, observing that all the colors are to be prepared with oil. For this purpose a series of blocks or types are to be provided for each subject, and which, when put together, will form the whole device. These blocks are to be used separately, that is, all the yellow parts of the picture, for instance, are to be printed at one impression, then all the red parts, next all the flesh color, then the blue portions, and so on, finishing with the black outlines, which complete the picture. If the same is to be done by lithography, there must be as many stones as there are to be colors, each to print its portion only; and the impression, or part of the picture given by one stone, must be exactly fitted into by the impression given from the next stone, and so on until the whole subject is complete.

A superior kind of card is proposed to be made, with gold or silver devices in parts of the pictures, or gold or silver borders round the pips. This is to be effected by printing the lines which are to appear as gold or silver, with gilder's size, in place of ink or color: and immediately after the impression has been given, the face of the card is to be powdered over with gold dust, silver, or bronze, by means of a soft cotton or wool dabber, by which the gold, silver, or bronze, will be made to adhere to the picture, and the superfluous portions of the metal will wipe off by a very slight rubbing. When the prints are perfectly dry, the face of the card may be polished by means of a soft brush. If it should be desirable to make these improved cards to resemble ivory, that may be done by preparing the face of the paper in the first instance with a composition of size and fine French white, and a drying oil, mixed together to about the consistence of cream; this is to be washed over the paper, and dried before printing, and when the cards are finished they will exactly resemble ivory.

The only thing remaining to be described is the means by which the successive impressions of the types, blocks, or stones, forming the parts of the pictures, are to be brought exactly to join each other, so as to form a perfect whole design when complete: this is by printers called registering, and is to be effected much in the usual way, by points in the tympan of the press, or by marks upon the stones. The parts of the subject having been all accurately cut or drawn to fit, small holes are to be made with a fine awl through a quire or more of the paper at once, by placing upon the paper a gauge-plate, having marks or guide-holes, and by observing these, the same sheet laid on several times, and always made to correspond with the points or marks, the several parts of the picture must inevitably register, and produce a perfect subject.

Card Cutting.—Mr. Dickinson's patent machine for cutting cards, (that now generally used,) consists of a pair of rollers with circular revolving cutters, the edges of which are intended to act against each other as circular shears, and the pasteboards in passing between these rollers are cut by the circular shears into cards of the desired dimensions. These rollers are mounted in suitable standards, with proper adjustments, and are made to revolve by a band and pulley connected to the axle of a crank, or by any other convenient means. Fig. 1 is a front view of this machine. AA and BB are the two rollers, the upper one turning upon an extended axle, bearing in the standards, the lower one upon pivots. These rollers are formed by a series of circular blocks, between a series of circular steel cutters, which are slidden on to iron shafts, and held together upon their axle by nuts screwed up at their ends. The accurate adjustment of the cutters is of the first importance to their correct performance: it is therefore found necessary to introduce spiral springs within the blocks, in order to press the cutters up to their proper bearings. A section of one of the blocks is shown at Fig. 3, and an end view of the same at Fig. 4, with the spiral springs inserted.

At the outer extremity of the axle of the roller A, a rigger C is attached, whence a band passes to a pulley D, on the crank shaft E, to which a fly wheel F is affixed, for the purpose of rendering the action uniform. Rotatory motion being given to the crank shaft, the upper roller is turned, the lower roller moving at the same time by the friction against the edges of the cutters. Fig. 2 is an end view of the rollers, showing the manner in which the pasteboards are guided and conducted between the cutters. In the front of the machine a moveable frame G is to be placed, for the purpose of receiving the pasteboards, preparatory to cutting them into cards, and a stop is screwed to this frame for the edge of the pasteboard to bear against, which stop is adjustable to suit different sizes. From the back part of this frame an arm H extends, the extremity of which acts against the periphery of a ratchet wheel I, fixed at the end of the roller B, and hence, as the roller goes round, the frame is made to rise and fall upon its pivots, for the purpose of guiding the pasteboard up to the cutters; at the same time a rod K hanging in arms from the sides of the standards, (shown by dots in Fig. 1,) falling upon the pasteboard, confines it, while the cutters take hold, and racks, corresponding with the indentations of the rollers, are placed as at L L, by means of which the cards, when cut, are pushed out of the grooves.

AUGER FOR MAKING SQUARE HOLES.

It appears that endeavours to supersede the tedious and somewhat difficult process of truly forming square and other shaped holes, varying from the circular, by means of mortice-chisels, were made both in this country and in America, at about the same period of time. A machine for this purpose, invented by Mr. A. Branch, of New York, was described in the Franklin Journal of Philadelphia, in the year 1826. It was stated to consist of an auger formed like the American screw auger, with the twisted part inclosed in a case or socket, extending from the upper part of the twist to the cutting edge, allowing the small entering screw to project beyond it. The external form of the socket is either square, or otherwise, according to the intended shape of the hole to be bored, a large portion of its sides being cut away to allow the chips to escape. The lower end of the socket is of steel, with a sharp cutting edge, bevelled towards the inside. The cutting-edges are not allowed to terminate in right lines, but are made concave, so as to admit the angular points to enter the wood first, thus-causing it to cut with greater ease, and more smoothly than it otherwise would. The upper part of the socket forms a collar, which works freely on the shank of the auger, just above the twisted part, and is retained in its place by a pin and other appendages. When a longitudinal hole or mortice is wanted, two or more augers are placed side by side, furnished with their appropriate sockets, and retained in their places by obvious contrivances. The same journal stated that it was very efficient in its operation, boring a square hole with well defined angles, with nearly the same rapidity as a round one of the same diameter, and forming it with a degree of truth unattainable by the ordinary methods.

Mr. Thomas Hancock, the engineer of Goswell Street Road, perfected a similar machine about the same period, and as it bores square holes with great facility, as they are clean cut, with the angles true and square, and exactly uniform throughout, we are induced to make a precise drawing of it, a representation of which, on a scale of a quarter of the original, is given in the subjoined engraving No. 5. At A A is a strong iron frame or support, fixed by screw-bits B B to the work-bench C; D is an octagonal iron socket, containing a brass bush, tapped to receive the vertical screw E E; to this screw is affixed, by a circular tenon and mortice, the square perforating instrument F, which accurately fits and slides up and down through a rectangular hole, in a guide of brass G, when the screw E is turned by the cross handle at top; so that the square incision is made by direct pressure downwards, at the same time that the revolving centre-bit M cuts out a completely round hole, the chips rising up and passing out at the two open sides of the square cutter; H represents a piece of wood in the act of being bored, the dotted lines showing the depth to which the perforation has reached; a small piece of wood I is placed underneath, to prevent injury to the cutting-tool, by coming in contact with the cross iron plate K; the bolts B B passing through I as well as K, secure both firmly to the bench C. Fig 6 exhibits the cutting part of the instrument, separately, on an enlarged scale, with the lowermost portion in section; the tenon I is inserted into a cavity in the screw E, Fig. 5, and made fast by a cross pin, which goes through both; by this arrangement the instruments can be readily exchanged for others of different

dimensions; the lower extremity of this revolving piece is formed into a centre-bit M, which, owing to the collars N N, cannot ascend or descend without the square instrument, which accurately cuts out the angles beyond the range of the circular incision made by the former. The square cutting-tool is made of a bar of steel, with a hole drilled out of the solid, in the manner shown by the end view, Fig. 7, and the edges are then formed by filing and grinding them to the bevels, or angles, shown in section by Fig. 6. Fig. 8 represents a similar view of the end of the instrument, but with the centre-bit in its place. It will be readily perceived that a square tool, by repeating the incisions side by side, close together, may be made to produce a cavity of the figure of any rectangular parallelogram of any length or breadth, larger than the instrument employed. The same effect may likewise be produced by a single operation, by arranging a series of centre-bits or circular cutters, side by side, with toothed wheels at their upper extremities or axes, giving into each other, which will cause them all to move simultaneously; a single external rectilinear cutter, embracing all the centre-bits, would then suffice for the purpose. In like manner, any acute or obtuse-angled figure, any polygon, or any figure with curved sides, might be made of any size whatever.

By the construction of the machine described, it will be perceived that it is necessary, in changing the tool, to change also the guide-piece through which it slides. The screwing and unscrewing of the guides may, however, be avoided, by having tenons in the latter of an uniform size, to fit in a mortice in the upright iron frame; and in manufactories where a great variety of mortices have to be made, we would suggest another mode, in which the trouble of changing the guides would be still less; it is to have a guide wheel turning horizontally upon the upright bar A as its axis; on the circumference of the wheel should be made a series of apertures, corresponding with the form of the tools and of the mortices required. By this arrangement, indeed, most of the tools might be left in the guide-wheel, ready to bring any one of them into the action under the screw, by just turning the wheel round.

In those branches of business wherein a great number of mortices are required of one size, a machine of the kind described will be most valuable; and as it requires no skill in the operator, a boy, or a mere labourer, will perform the operation as well as the most experienced workman. Chair makers might adapt a machine on this principle to their work with important advantages; wheelwrights, also, for morticing out their naves. In the large work-shops of carpenters, an instrument of the kind described would forward a great deal of work in framing, as it might easily be so modified as to perform the office also of a clamp to draw the jointed parts of the work into close contact. It is to be observed, that Mr. Branch's instrument is the same in principle as Mr. Hancock's, but that it will require some modifications to render it as efficient an instrument.

THE LIGHT OF THE SUN AND MOON.

THE comparative proportion which the light of the moon bears to that of the sun is a very curious problem, but it is only within these few years that philosophers began to turn their attention to the principles and means which can lead to the solution of it. We are indebted for them to M. Bouguer,

who has explained them in his "Treatise on the Gradation of Light;" a work that contains many curious particulars, a few of which we shall here extract. To obtain this measure of the intensity of light M. Bouguer sets out with a fact, founded on experience, which is, that the eye judges pretty exactly by habit, whether two similar and equal surfaces are equally illuminated. Nothing then is necessary but to place at unequal distances two unequal lights, or by means of concave glasses, the focal distances of which are unequal, to make them be unequally dilated, so that the surfaces which are illuminated by them shall appear to be so in an equal degree. The rest depends merely on calculation; for if two lights, one of which is four times nearer than the other, illuminate equally two similar surfaces, it is evident that, as the degrees of illumination of the same light decrease in the inverse ratio of the squares of the distances, we ought to conclude that the splendour of the first light is sixteen times as great as that of the second. In like manner, if a light dilated into a circular space, double in diameter, illuminates as much as another direct light, there is reason to conclude that the former is quadruple the second.

By employing these means, M. Bouguer found that the light of the sun diminished 11664 times was equal to that of a flambeau, which illuminates a surface at the distance of 16 inches, and that the same flambeau illuminating a similar surface, at the distance of 50 feet, gave it the same light as that of the moon, when diminished 64 times. By compounding these two ratios he concludes, that the light of the sun is to that of the moon, at their mean distances and at the same altitude, as 256289 to 1; that is to say, 250,000 times greater. From some other experiments he is even inclined to think that the light of the moon is only equal to the 300,000th part of that of the sun.

The result of a celebrated experiment, made by Couplet and La Hire, two academicians of Paris, needs therefore excite no surprise. These two philosophers collected the lunar rays by means of the burning mirror at the Observatory, which is 35 inches in diameter, and made the focus fall on the bulb of a thermometer, but no motion was produced in the liquor. And indeed this ought to be the case, for if we suppose a mirror like the above, which collects the rays that fall on its surface into a space 1200 or 1400 times less, the heat thence resulting will be 1200 or 1400 times greater; but, on account of the dispersion of the rays, it will be sufficient to suppose the light to be a thousand times denser than the direct light, and the heat in proportion. A mirror of this kind then, by collecting the lunar rays, would produce in its focus a heat 1000 times greater than that of the moon. If 300,000 therefore be divided by 1000, we shall have for quotient 300, which expresses the ratio of the direct solar heat to that of the moon thus condensed. But a heat 300 times less than the direct heat of the sun is not capable of producing any effect on the liquor in the thermometer. This fact then is far from being inexplicable, as we are told by the author of the "History of the Progress of the Human Mind in Philosophy," for it is a necessary consequence of Bouguer's calculations, which this writer no doubt overlooked. We shall, in the last place, observe, that Bouguer found, by a mean calculation, that the splendour of the sun, when on the horizon, supposing the sky to be free from clouds or fog, is about 2000 times less than when elevated 66° . The case ought to be the same also with the light of the moon.

MANUFACTURE OF PAPER HANGINGS.

Flock papers, or rather hangings, were introduced into England in the time of Charles I. A person named John Lanyer, obtained a patent for the invention in 1634. An article in an old French Dictionary of Commerce, proves that the colored paper-hangings were made at any rate in that country in the seventeenth century, and referring to statutes relating to them even of the date 1586.

There were formerly three modes in which paper hangings were manufactured. First, by printing the outline with blocks and then coloring by hand.

Secondly, stenciling, which is performed by cutting out either in paper, leather, or other materials, the pattern intended to be represented, and then placing this on the prepared ground, brushing it over with the proper color. This mode gives an imperfect outline, and is now discontinued in paper staining, and merely sometimes employed by plasterers to ornament colored walls.

The third is the mode now almost universally adopted in this manufacture, whereby every color is applied by a separate block, according to the tints and shadows intended to be represented.

Lanyer's patent did not even mention paper among the substances on which flock could be applied, as it was at that period of too rotten and bad a quality to bear the weight of the woollen material. But paper has now been brought to so high a degree of perfection that it is the only substance employed, and has thus assisted greatly the operations of the paper stainer. Till within the last twelve years the pieces of paper hangings were formed of sheets, each about $\frac{1}{2}$ of a yard long, pasted together till the proper length of twelve yards was completed. This method was attended with many inconveniences, the joints rising, or being imperfect, and generally showing, all which evils are now remedied by the pieces consisting of one perfect length of paper, without any joints whatever; the width, too, can be enlarged to two or three times the ordinary size, as is now repeatedly done in France, though we have not as yet adopted this plan.

The modern colored papers are almost all worked in distemper, or color mixed with size to bind it, instead of with oil or varnish, which was more employed formerly, and is now, in fact, used in the manufacture of the washable paper hangings; the effect of them, however, is not nearly so clear and brilliant as in those worked by the former method.

Distemper, or body color, is generally thus prepared:—Whiting finely powdered and soaked in water is first well mixed, as stiffly as it can be worked, and then stained with the proper colors, well ground in water; when the desired tint is produced, double size melted with about an equal proportion of water is added, till the color is about the consistency of cream, and when chilled it is fit for use.

Commencing with the more simple papers, the first process is that of laying the grounds; to do this, the paper being placed on a bench about 12 feet long, the workman with two large brushes filled with color, one in each hand, passes them over the paper with a circular motion, and as each piece is completed it is supported and carried by the attending boy on a stick, and placed on the rack to dry. An ingenious machine has lately been invented, in which by three brushes acting, one with the other, the grounds are completely and evenly colored, and in a much more expeditious manner than by hand. The grounds being prepared, we will proceed with

the printing, which is performed by means of blocks. They are carved most generally in pear tree, mounted on white deal; the design being first traced on the wood, the engraver or cutter, taking care to follow the exact outline, cuts perpendicularly to the depth of $\frac{1}{2}$ of an inch, and then slopes off till he gets to the deal. It should be added, that where very sharp lines or dots are required, metal is inserted in the block.

The color with which the printing is to be performed, being mixed to the proper tint, is spread with a brush on what is called the sieve—a wooden frame covered with a blanket—the block is pressed on this and then applied to the paper, on which it leaves the impression of the design. There is a method of printing by a patent machine, invented by Messrs. Archer and Taverner, whereby, by placing the blocks on the sieve and then on the paper is performed with great exactness, with the labour of merely turning a lever handle, which is done by a boy. It was found, however, too cumbersome to move.

In the first case the pattern is given to the paper by a single block, but as in the second, where there are two shades of color, two blocks are necessary. Now, in order that the second block may be placed exactly in its proper situation, you perceive that there are pin marks in each block corresponding with each other, and on the marks printed by the first block the pins of the second block are placed, and the pattern is thus completed with the required correctness. In another case a very delicate and shaded effect is given by a single impression, which is produced by what is called pin-work on a cylinder. The pattern is formed by small brass pins of various sizes, fixed on a wooden cylinder at different spaces, according to the depth of shade required. This, fixed in a machine, is made to revolve so as to be supplied with color from a blanket, and at the same time print the piece of paper very speedily without any interruption. This process, only lately applied to paper staining, is derived from one much resembling it, in use in calico printing, only that the latter so far differs that the color is contained inside the cylinder, and the pattern represented by holes pierced in it instead of pins fixed on it.

In other cases the pattern is worked on what is called a blended ground; this is also a modern invention, originating in France. The blending is performed by a machine purposely constructed. A metal trough, the length of the breadth of paper, containing about 20 divisions, has in those divisions various tints of color, according to the blending required; a long narrow brush is then dipped into the trough, and being filled with color, applies it to a roller, from which it is collected by a large cylindrical brush the same length, which is made to revolve, and when it is properly supplied with color it is then brought to bear upon the paper, on which it thus places the grounds, though in order to make it sufficiently perfect it is necessary to be done twice.

A common marble paper is printed by blocks in the ordinary way, and afterwards varnished with turpentine varnish, by which process it is enabled to bear washing, water not injuring it.

There is an improved imitation marble paper, in which, if assisted by a few veins laid in by hand, the effect is certainly much superior to the last. The operation is considered secret, but it is easy to be perceived that the mode of making it nearly resembles that employed by the makers of the bookbinders'

marble paper, in which thickly gummed colors are made to float on the surface of the water, and being stirred in various forms are thus absorbed by the paper when applied to them. In an imitation of wainscot the ground is combed as in the usual painted imitations of this wood, and the veins are afterwards printed. The satin ground paper is a great improvement on the common grounds, and enables the manufacturer to produce imitations of silks and satins, which have a very elegant appearance. The satin ground is laid with satin white, a compound formed of lime and alum, and it can be colored to almost any tint. After being laid like the common grounds, powdered French chalk is rubbed on it with a hard brush till the gloss is produced, and it is then glazed with clear size.

A process has been invented in England within the last five or six years, which adds materially to the beauty of the satin grounds; this is embossing, where imitations of watered and figured silks, stamped leather, &c. are produced. The embossing is performed by the paper being passed between two rollers, on one of which is the engraved pattern, and which also being slightly heated thus stamps the required design on the paper.

A kind of paper hanging in which the English designers seem to excel is called chintz, and has been introduced in imitation of the printed cottons and muslins, which seem to have been copied from Indian designs. There are in general several colors in these patterns, requiring many blocks and much delicacy in execution, though the number of blocks is sometimes much lessened by printing wash colors; such as yellow on blue making green, yellow on red orange, and lake on blue purple.

A manufacture of Archer and Taverner is one of the most creditable attempts in modern English paper staining. It is an imitation of Chinese paper, and is composed of 18 sets of blocks, each set containing 4, altogether 72 blocks. It will be perceived that the flowers in that paper are shaded, which is effected by a process resembling that employed in blending the grounds. The long narrow brush is dipped in the trough containing the proper tints of color, and spreads these on the sieve. The block with the flowers engraved on it is then applied to the sieve thus arranged in shades, and afterwards prints the flowers in the tints, which are blended. This is a modern invention, first practised about five years ago by the Messrs. Harwood, the oldest firm at present in the trade.

Another important mechanical contrivance was invented about twenty years ago, whereby striped papers are executed with great exactness and clearness by a machine in lieu of blocks, which owing to the working always made an imperfect line. In this machine a copper trough, in which narrow slits of the required breadth are cut at the bottom, being filled with thin color, is applied to the paper, which is made to pass over a revolving cylinder, and draws the colors through the slits in the trough, by which the stripes are formed.

Crimson paper is laid with a staining color instead of distemper. This color, prepared principally from cochineal, is applied to the paper in the form of a wash, and is generally laid six times to produce a fine stain, the first coat being done with gamboge. In working the pattern it is printed before the staining is done, and thus acquires a much greater richness of color.

Flock paper is a kind of hanging originally introduced as an imitation of the wove tapestries and

velvet damasks. It has been employed in England more than 200 years, and about sixty years ago the art was almost lost, and only revived forty years since. The mode of working is very simple, although much mystery used to be observed respecting it. Flock is composed of the cuttings of white or bleached woollen cloth cut up in a mill to the necessary degree of fineness and then dyed to various tints of colors. It is applied to the paper in the following manner:—The ground being prepared, the design is first printed with the block in size, in order that the oil may bear out when applied; when this is dry it is then printed with a composition of boiled oil and japan gold size, and while this is still wet the paper is laid on the drum (a kind of box about 5 feet by 3 feet, with the sides of wood and the bottom of ticking); the flock is then sprinkled over the paper, and the workman, with a cane, beats the under side of the drum, which causes the flock to spread evenly over every part of the pattern, to which it is fixed by means of the japan composition. Sometimes one flock is applied over another; this is easily accomplished by merely repeating the process after the first flock is perfectly dry. A beautiful imitation of tapestry is produced by the introduction of flocks of various colors, and is done exactly as in the former examples, each flock being separately printed after the former ones are properly hardened and set.

Metallic paper hangings.—The last of the three kinds of paper hangings, is that wherein metals are employed to produce imitation of gilt leather, rich brocades, or lightly etched ornaments. It is to these papers that our manufacturers seem now to devote their chief attention, and they work them with great beauty and richness, at a comparatively moderate price. Gilt leather was employed in England even in the time of Henry VIII, and the English were afterwards famed for its manufacture. There is a material of recent introduction, called bronze or imitation gold dust, which is now very extensively employed. This bronze is the invention of an artist at Nuremberg, named John Hahltsch, who was born in 1595, and died in 1670, and his descendants have continued the manufacture to the present time. It is prepared by sifting the filings of different metals, washing them in a strong lye, and then placing them on a plate of iron or copper over a strong fire, where they are continually stirred till the color is altered. Those of tin acquire by this process shades of gold color, copper, red, and flame colors; iron and steel, blue and violet; and tin and bismuth, shades of a bluish white. The dust tinged in this manner is then put through a flapping mill.

A bronze paper is thus worked:—The design (as with flock) is first stamped with size, and afterwards with boiled oil and japan gold size; this preparation is allowed to dry, but while it still retains a tack the bronze is brushed over with a hare's foot or soft brush; it thus adheres to the gold size, and the paper is in the state exhibited. In another paper a much more splendid effect is produced by a metal, in imitation of gold leaf. A gold size, resembling that for bronze, is first applied, and while it has a tack the metal leaf is laid on. This metal, sometimes called mosaic gold or Dutch metal, is prepared in Germany, and is an amalgam of tin and copper. The effect of it on the paper is very much improved by embossing.

When colored flocks are united with the metal pattern, very splendid hangings are produced.

The metal, too, is sometimes shaded, which is done by stains formed from berries, of which various kinds are used; and metal is also applied on a bronze ground, but the process is simply that already described. It need not be added, that in all cases where the metal is employed gold leaf may be substituted, but it is rarely used on account of the great increase in price. The *washable paper hanging*, or *De la Rue's patent paper hangings*, are similar to those already spoken of, with the exception that they are worked with japan gold size and turpentine instead of distemper, and the latter by being embossed in horizontal lines, forms, by embossing alone, a pattern similar to that produced by printing.

TO MAKE CRUCIBLES.

MR. CHARLES CAMERON, Glasgow, has published a description of a new method of forming crucibles. The Dutch have long enjoyed an almost exclusive monopoly in the manufacture of the small melting-pot or clay crucible, used by the jeweller and silversmith. I established a small manufactory of them, as follows: for each of the different sizes of the crucibles, I formed ten or twelve dozen of moulds of stucco, burnt and powdered in the usual manner. For the first mould of each size, I formed a piece of soft pipe clay into the shape of the intended crucible, and laid it with its mouth downwards on a flat surface, and inclosed it with a cylinder of white-iron (tin), distant about half an inch from the angular points of the crucible, and about an inch and a half higher than its bottom: then mixing the stucco with water, poured it into the cylinder. When the stucco was sufficiently set, I removed the white-iron, picked out the clay, and dried the mould. I then squeezed soft clay into the mould, which on standing a few minutes, easily came out again. It was inclosed in the cylinder, and stucco poured round it, which formed a second mould, continuing to do so until I had procured the number wanted. They were then all put into a stove, and completely dried ready for use. In the preparation of the fire-clay for the crucibles, I followed precisely the same process used at the potteries, by mixing it with a very large quantity of water, and putting the whole through a No. 9 silk sieve. On allowing the whole to stand a few hours, the clay subsided, and in pouring off the clear water, I procured the clay or slip of the consistence of thick cream. On weighing a gallon of it, I found the proportion of clay it contained, and added sand to the whole in the proportion of 7 of sand to 17 of clay; I then stirred and mixed the whole completely, when it was ready for use. I next took my moulds, previously dried, and arranged them in parallel rows on a table, and successively filled them with the prepared slip. By the time I had filled 4 or 5 dozen, I returned to the one first filled, and began alternately to pour the slip out of them, leaving a small quantity unpoured out, which subsided, and gave the requisite thickness to the bottom. In each of the moulds so filled, a crucible is completely formed by the abstraction of the water of the slip, in contact with, and adjoining to, the porous substances of the stucco mould. The crucible will be either thicker or thinner in proportion to the time the slip has remained in it. Five or six dozen will not require more than 15 minutes in being formed. The moulds with their contents are then removed to a stove, placed on their side and built one above

the other. In a short time, from the contraction of the clay, the crucibles easily part from the moulds, and are removed by introducing the finger into them. The moulds are allowed to remain in their situation until the water they had absorbed is completely evaporated, when they are again ready for re-filling, and will last for years. The crucibles remain in the stove until dry, after which they are burned in a kiln in the usual manner.

METHOD OF REVIVING FADED PLANTS.

THIS is called a proved method of reviving plants, &c., when their leaves and buds are faded, and their bark and roots hard and nearly dry, by M. de Droste, of Hülshof. The directions are to dissolve camphor to saturation in alcohol, adding the former until it remains solid at the bottom of the latter; a sufficient quantity of rain or river water is then to have the alcoholic solution added to it, in the proportion of four drops to one ounce of water. As the camphor comes in contact with the water, it will form a thin solid film, which is to be well beaten up with the water: for a short time the camphor will float in the water in small flocculi, but will ultimately combine with the fluid, and disappear.

Plants which have been removed from the earth, and have suffered by a journey or otherwise, should be plunged into this camphorated water, so that they may be entirely covered; in about two, or at most three hours, the contracted leaves will expand again; the young faded and dependant shoots will erect themselves, and the dried bark will become smooth and full. That being effected, the plant is to be placed in good earth, copiously watered with rain or river water, and protected from the too powerful action of the sun, until the roots have taken good hold of the ground.

When large plants, as trees, are to be revived, their roots are to be plunged into the camphorated water for three hours; the trunk, and even the head, of the tree being frequently wetted with the same water, so as to retain them in a proper moistened state. But it is always best, if possible, to immerse the whole of the plant. Shoots, sprigs, slips, and roots, are to be treated in a similar manner. If plants thus treated are not restored in four hours, their death may be considered as certain, for they cannot be recalled to life by any artificial means. They should, consequently, never be left more than four hours in the camphorated bath; because the exciting action of the camphor, when it is continued for a longer period, may injure the plants, instead of doing good to them. It is not necessary to say that the final prosperity of the plants, thus re-animated by the camphorated water, must depend upon the particular properties of the former, the state of their roots, and the pains that are taken with them. The camphor produces no other effect than to restore life to plants nearly dead: after that, all proceeds according to the ordinary laws, and their ultimate state must be left to art and nature.

VIEW OF THE HEAVENS,

On January 16th, at Nine o'Clock in the Evening.

WE gave last week an account of the methods of finding the names of the stars, and as a further assistance to the young astronomer we give the appearance of the heavens at the present season of the year. At this time the Pleiades, or Seven Stars, are nearly on the meridian, at an elevation of more than

60 degrees above the southern horizon. The bright star Aldebaran, or the Bull's Eye, which is of a ruddy hue, appears to the left, in a direction nearly east by south, at the distance of 14° . About 15° east-north-east of Aldebaran is a bright star of the second magnitude, marked Beta, or El-Nath; from this star Zeta, in the tip of the southern horn of the Bull, is about 8° in a southern direction. This star forms a right angle with Aldebaran and Beta. North of Beta, at the distance of 17° , is the bright star Capella, in the constellation of Auriga, a star of the first magnitude, which appears at a high elevation a few degrees south-east of the zenith. In a direction south-east of Aldebaran and the Pleiades is the splendid constellation of Orion. Bellatrix, on the west shoulder of Orion, is about 16° south-east of Aldebaran, which is placed in the middle of the line which connects the Pleiades with Bellatrix; these three objects appearing nearly equidistant in a line N.W. and S.E. of each other. Nearly due east from Bellatrix, at the distance of $7\frac{1}{2}^{\circ}$, is Betelgeuse, a star of the first magnitude in the east shoulder of Orion. About 15° south by west of Bellatrix is Rigel, a star of the first magnitude in the left foot, and $8\frac{1}{2}^{\circ}$ to the east is Saiph, a star of the third magnitude in the right knee of Orion. These four stars in the form of a parallelogram, with the three bright equidistant stars called the Belt, form the outlines of this constellation. There is a small triangular of three small stars in the head of Orion which forms a larger triangle with Bellatrix and Betelgeuse, the two in his shoulders.

North-east of Betelgeuse, at the distance of 14° , is the star Alhena, or γ Geminorum, the principal star in the feet of the Twins; and about 20° N.E., nearly in the same right line from Betelgeuse, are Castor and Pollux, Castor being the uppermost and the brightest, at the distance of only $4\frac{1}{2}^{\circ}$ from Pollux. These and the other stars which lie adjacent to them form the constellation Gemini, one of the signs of the Zodiac. The small stars immediately to the east of Gemini are in the constellation Cancer, another zodiacal constellation through which the sun passes in July and August. In this constellation is a nebulous cluster of very small stars, called Præsepi, which may be distinguished as a faint cloudy speck by the naked eye.

Immediately below Orion are the constellations of Lepus, or the Hare, and Noah's Dove, which are very near the horizon. South by east of Orion is Canis Major, or the Greater Dog, which is distinguished by its principal star Sirius, the brightest fixed star in the heavens. It is nearly straight south of Alhena, in the feet of the Twins, at 35° distant, and south by east of Betelgeuse at the distance of 27° . A line drawn through the three stars in the belt of Orion, and prolonged, meets Sirius at the distance of 23° . About $5\frac{1}{2}^{\circ}$ west of Sirius is Mirzam, of the second magnitude, in the foot of the Dog. Nearly due east from Orion, but less elevated above the horizon, is Canis Minor, or the Lesser Dog. The centre of this small constellation is situated about 5° north of the equinoctial, and midway between Gemini and Canis Major. It is distinguished by the bright star named Procyon, which signifies "before the Dog." About 4° to the north-west is Gomeiza, a star of the third magnitude. Procyon, at the time supposed, appears nearly due east from Betelgeuse, at the distance of about 26° . The head of Hydra lies immediately to the east of Procyon; but Alphard, or Cor Hydre, the principal star of this constellation, is not risen

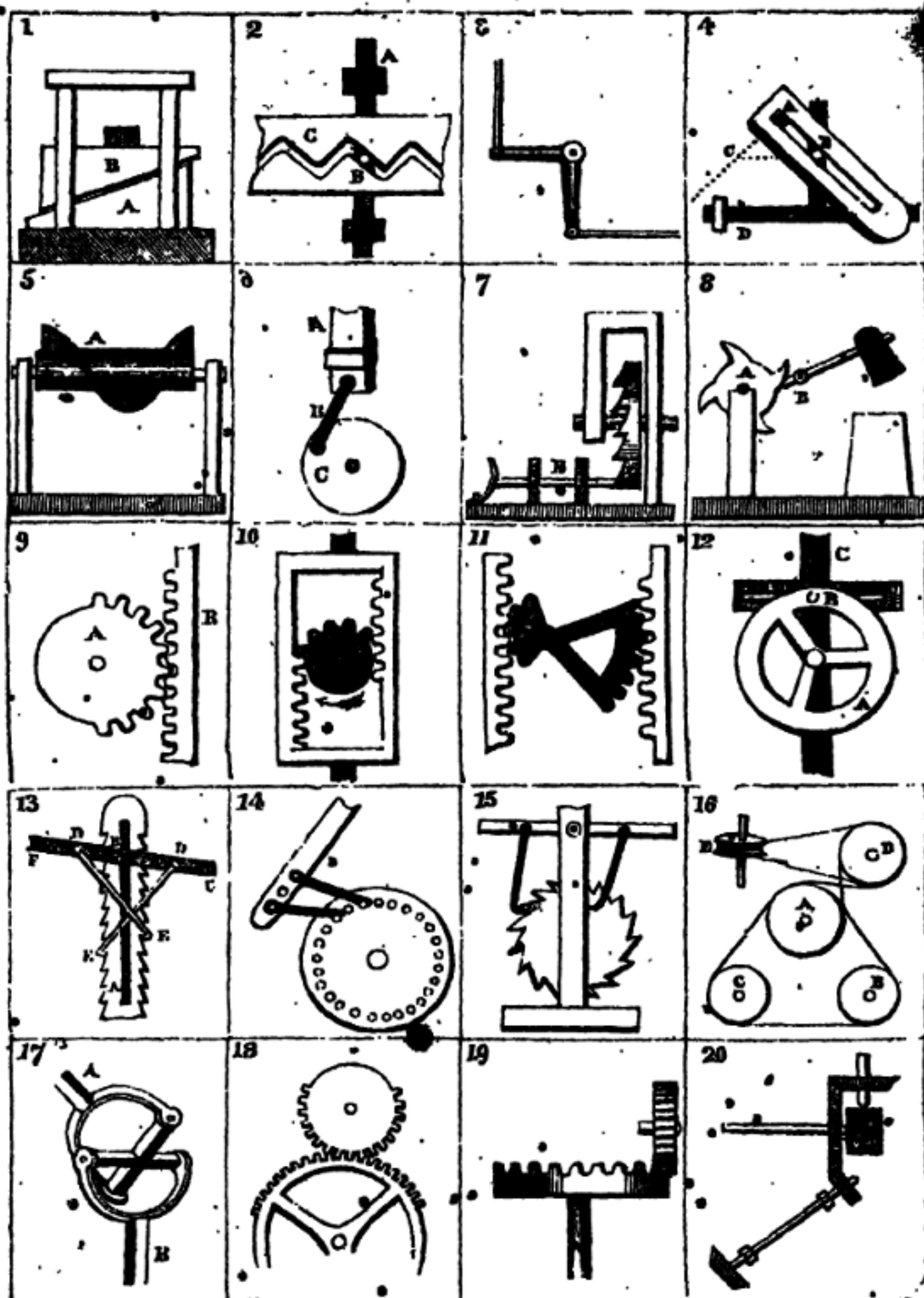
at the time supposed. A little to the north of the eastern point of the compass, and at a very small elevation above the horizon, is Regulus, a star of the first magnitude, in the constellation Leo, which is the fifth sign, and the sixth constellation of the zodiac.

Turning our faces towards the north-east, Ursa Major, or the Great Bear, is the most striking constellation that meets the eye. The two pointers, Dubbe and Merak, appear uppermost, and point westward to the Pole-star; while the stars forming the tail seem to hang downwards from the square of this constellation. As the night advances, this group of stars rises higher in the heavens, till, about three in the morning, they approach near the zenith. Ursa Minor, or the Lesser Bear, is seen below the pole, the square of which being a little to the eastward of the meridian. Directly below the Great Bear, at a very small elevation above the horizon, and in a direction N.E. by N., is Cor Caroli, a star of the second magnitude, in Chara, one of the Greyhounds. North by east of Aldebaran, at the distance of 30° , is the bright star Capella, in Auriga. Directing our view a little to the west of the meridian, we perceive the constellation Aries, which is immediately to the westward of the Pleiades, and nearly, at the same altitude. About 2000 years ago, in the days of Hipparchus, this constellation occupied the first sign in the zodiac, into which the sun entered about the 21st of March; but, as in consequence of the precession of the equinoxes the constellations gain about $50''$ on the equinox every year, they have now advanced in the ecliptic nearly 31° beyond it, or somewhat more than a whole sign; so that the constellation Pisces now occupies the same place in the zodiac that Aries did 2000 years ago, while the constellation Aries is now in the sign Taurus, Taurus in Gemini, &c., so that Aries, though the first sign, is the second constellation of the zodiac. It is situated next east of Pisces, and midway between the Triangles and Musca on the north, and Cetus, or the Whale, on the south. It is distinguished by two bright stars in the head, distant from each other about 4° , the brightest being a little to the east or north-east of the other, being about 25° west of the Pleiades, and 19° south of Almaack, in the foot of Andromeda. North by east from Aries is Musca, or the Fly, which consists of four or five stars, chiefly of the third and fourth magnitudes, very near to each other. It is situated between the first star of Aries and the Pleiades, but a little higher than either. North by east from the Fly, at the distance of about 15° , and at 20° north by west of the Pleiades, and at a higher elevation, is the head of Medusa, the principal star of which is Algol, which regularly varies in its lustre. West by north from Medusa is Andromeda, one of the principal stars of which is Almaack, at the distance of 12° west by north of Algol. West of Almaack, at the distance of 12° , is Merach, both of them stars of the second magnitude. If the line connecting Almaack and Merach be prolonged 8° further west or south-west, it will reach Delta, a star of the third magnitude in the left breast.

West from Andromeda, and a little to the south, is Pegasus, or the Flying Horse, which is distinguished from the other constellations by four bright stars of the second magnitude, forming a square, which is generally termed the Square of Pegasus. The northernmost star, which is the brightest of three that form a kind of triangle, is Scheat, whose N.

declination is $26\frac{1}{2}^\circ$. Markab is situated 13° south of Scheat, and at the time supposed is nearly due west, and about 22° above the western point of the horizon. These two stars form the western side of the square. East from Markab, at the distance of $16\frac{1}{2}^\circ$, is Algenib, and 14° north of Algenib is Alpheratz; which two stars form the eastern side of the square. Scheat and Alpheratz form the northern, and Markab and Algenib the southern sides of the square. Alpheratz constitutes a part of the head of Andromeda, but it is also considered as connected with Pegasus. About 26° north of Andromeda is Cassiopeia, midway between it and the Pole-star. It passes the meridian nearly in the zenith about the 22nd of November. At this time it is between 20° and 30° west of the meridian. The star Caph, in this constellation, along with Alpheratz and Algenib, are situated on the prime meridian which passes through the first point of Aries, from which the right ascensions of all the heavenly bodies are measured. The line connecting these stars forms an arc of the *equinoctial colure*, which passes through the vernal equinox, and across which the sun passes on the 21st of March. When we say that the sun, or a star, or a planet, is in so many degrees of right ascension, we mean that it is situated, or has moved eastward so many degrees from this great circle. North-west of Cassiopeia is Cepheus, at the distance of about 25° , the head of which is in the Milky Way, and may be known by three stars of the fourth magnitude in the crown, forming a small acute triangle about 9° from Alderamin, a star of the third magnitude in the left shoulder.

Next to Cepheus, on the west, is Cygnus, or the Swan; the principal stars of which are distinguished as forming the figure of a large cross, the upright piece of which lies along the Milky Way. The most brilliant star in this constellation is Deneb Cygni, of the first magnitude, which is at this time in a direction nearly north-west, and 25° above the horizon. West from Deneb, at the distance of 10° or 11° , is Delta; and the line prolonged about 15° further leads to the bright star Vega, the principal star in Lyra, which is then about 6° above the horizon in a direction north-west by north. North by east of Lyra is the head of Draco, distinguished by four stars separate from each other by intervals of 3° , 4° , and 5° . The one to the south, or nearest Lyra, is Etanim, or γ Draconis, which Dr. Bradley fixed upon in his attempt to determine the annual parallax. At this time it is 16° above the horizon, in a direction N.N.W. About 4° to the north of it is Rastaben, both of them stars of the second magnitude. Turning our eyes again towards the southern part of the meridian, we behold the head of Cetus, or the Whale, about 20° S.E. of Aries, and about 24° S. by W. of the Pleiades. It is distinguished by five stars, 4° or 5° asunder, which form a figure resembling a regular pentagon. The brightest of these stars, which is the easternmost, and of the second magnitude, is Menkar, which makes an equilateral triangle with Arctis and the Pleiades, being distant from each about $23\frac{1}{2}^\circ$. About 14° south-west of Menkar is Mira, or the Wonderful Star, which is found to vary its apparent size from a star of the second or third, to one of the sixth or seventh magnitude. North-west of the head of Cetus, and west of Aries, is the constellation Pisces, or the Fishes, one of the signs of the zodiac, in which there are no remarkable stars, most of them being of the third, fourth, and inferior magnitudes.



MECHANICAL CONTRIVANCES.

MECHANICAL CONTRIVANCES.

ONE of the great ends to be attained by machinery is the change, or modification of motion. Our impelling power may be rectilinear when a circular motion may be required in the working point, or the impelling power may be alternate, or reciprocating, when the force required at the working point is continuous. In a word, the motion of the impelling power may be of any one species, and that required at the working point may be of any other species. It is, therefore, a very important problem to assign the nature of the machinery which should be interposed between a given impelling power and the working point, so as to produce at that point the effect required. This problem, in its most general form, it is evidently impossible to solve; nor is it easy to enumerate all the different motions which the impelling power may have, nor the various motions which these may be required to produce at the working point. Generally speaking, however, the motions which we meet with in the use of machinery may be resolved into *rectilinear* and *circular*, that is, one in which the points of the moving part describe parallel straight lines, or one in which they move in circles round a common centre or axis. These, again, may be divided into *continued* and *alternate*, or *reciprocating*; that is, the point which moves in a straight line may move continually in the same direction, or it may move backwards and forwards, or upwards and downwards, its range being limited by two points on the straight line in which it moves. Again, if the point move in a circle, it may move constantly round the centre in the same direction with a continued rotatory motion; or, on the other hand, it may only move over an arc of the circle in one direction, and then return through that arc in the opposite direction, and so on alternately, having a vibrating or reciprocating motion in the circular arc. The motions which we have to consider may then be resolved into the four following:—1. Continued rectilinear motion. 2. Reciprocating rectilinear motion. 3. Continued circular motion. 4. Reciprocating circular motion.

We shall devote the present, and two other papers, to explain some of the contrivances by which each of these may be modified or converted one into another. If the directions of the two motions be in the same plane, this may evidently be effected by a fixed pulley. But if the directions be in different planes, two fixed pulleys will be requisite, one being in the plane of the direction of one motion, and the other in the plane of the direction of the other motion.

In Fig. 1, a contrivance is represented, by which a rectilinear motion in one direction is made to produce a rectilinear motion in a direction at right angles to the former. The inclined plane or wedge A is moved under B, which is connected by guides with the pillars of the frame. It is evident, that as A advances forwards, B rises in the vertical direction. The wind acting on the sails of a ship in one direction, gives the vessel a rectilinear motion in another direction.

Fig. 2, represents a method of producing an alternate up and down motion in the rod A, by means of a waved slot or hole in the horizontal pieces B and C; suppose the perpendicular rod A have a pin projecting from it, as shown at B, and that B were inclosed in a zigzag channel, as represented; if the rod A be confined from moving sideways by guides, it will rise and fall as C is moved forwards.

Now suppose C is a portion of a wheel or drum, and A outside of it, it stands to reason, that as the motion of C may be made continuous; so will also the reciprocating motion of A; and any number of upright rods, attached in like manner around the wheel, will move upwards and downwards. If the machine is to work perpendicularly, and the rods be heavy, or can be kept to their work by a spring to each, the upper part of the drum C may be dispensed with; but if to work in a horizontal direction it may be advisable to keep C on. To diminish friction the pin B may have a friction wheel upon it.

Fig. 3, shows a bell crank motion; it is understood at sight, and is a most simple, useful, and common means of continuing a rectilinear motion from one part to another, and altering its direction, and often its amount. Thus if the arms of the bell crank are unequal, the relative quantity of motion of the rods connected with it is materially affected.

Fig. 4, shows a means of converting a swinging motion into a horizontal one, or vice versa. Suppose A in the figure stationary, and the lower end of the swinging piece moved horizontally, the consequence will be that the pin B will describe a straight line across as B C, so also will D; or on the contrary, if D be moved horizontally to and fro, it will produce a swinging motion in the front piece. According to the height of the pin B, so will be the amount of the effect or relative degree of motion of the two parts.

Fig. 5, shows the Archimedes screw. If a screw or thread like that of a common screw, but greatly projecting from the central portion, be fixed to an axis capable of motion, and water or air flow or blow against the screw, although the force be rectilinear, yet the effect will be to produce circular motion.

Fig. 6, shows another method of producing a circular motion from a reciprocating straight one. Let the beam A be connected with the wheel C by the moveable rod B. If A be moved up and down in short jerks, the wheel C will also be moved partly round and back again in equal time; but if the rod B be twice as long proportionably as it is in the cut, and the motion of A be also greater, the wheel C will turn completely round. Reversing the operation and turning the wheel, as we would a grindstone, and putting A horizontal, we have the means of grinding and polishing the surface of marble, &c.

Fig. 7, is a modification of Fig. 2, but working in a horizontal direction. As the wheel turns round, the rod B which is kept close to the face of it by means of the spring at the end, moves backwards and forwards, according to the teeth of the wheel.

Fig. 8, involves the same principles as the last, except that the motion is in a different direction, and the part moved is set free at a certain part of its progress. Suppose the wheel A to be turned round, the wipers upon it catch the handle of the hammer, and that being moveable only round the pivot E, the handle is lifted up four times each revolution of the wheel; the wipers catching the handle each time. Thus forge hammers are contrived. The speed of A should be such as to allow of the hammers making their full stroke before being lifted up again. If the wipers were arranged along a drum, and the hammers put in a row, the effect would be the same; so also an upright shaft may be lifted up and down by a similar wheel drum with wipers, as we see in some childrens' toys. A machine for ramming down the stones in the street was once contrived upon this principle, but the great noise attending it prevented its use. The action of the organ barrel and its pegs is similar to this.

Fig. 9, explains itself. If the rack be of great length, and the wheel A have cogs around its whole circumference; upon A turning round, it would drag B with it, or if B be the fixture, as for example, the line of a railway, and one of the carriages have wheels like A with cogs all round them, it would run along B; but if A be a fixture by its centre and have cogs only half round it, or a quarter round it, it would move B only a certain distance; and when there were no other cogs to take hold of it, B would fall of its own weight, to be raised up again at the next half revolution of A.

Fig. 10. This shows how the wheel may be made to produce both the up motion and the down motion, if requisite that it should do so. The wheel as will be seen engages first one side of the rack, and then the other alternately.

Fig. 11. If it be required that the rack should move faster one way than the other, all that is requisite is to have the wheel in the centre formed of two unequal arms, when as a matter of course that rack which is worked by the longest arm will move the fastest in the given time.

Fig. 12. This is a very ingenious contrivance to produce an alternate rectilinear motion. A is a wheel turned by a winch or otherwise; C is a beam which moves through guides to keep it steady; attached to this beam is a cross piece, having a groove cut in it. This groove receives a pin B. As the wheel revolves, the pin B moves in the groove from one to the other end, and thereby depresses and raises the beam through the guides.

Fig. 13, is called the lever of Lagaroust; it is a contrivance by which a reciprocating circular motion produces a continued rectilinear one. Behind the rack A B is supposed to be a fixed beam, having a projecting pin shown in the middle of the cross lever near B. A B is a double rack moving up and down on the before-mentioned pin; F C is a fixed vibrating lever fixed on the same pin. Upon C F are two loose arms as D E, hooked at the end, and swinging on pivots at D D. As the beam or lever C F vibrates, the hooks catch alternately on the opposite sides of the rack and move it upwards.

Figs. 14 and 15, are contrivances of the same nature, and acting upon the same principle.

Fig. 16, shows various methods of altering the direction of motion in machinery worked by bands passing over wheels or drums. Suppose A to be the moving wheel for the whole; B and C are moved by the bands which passes over A and themselves; they turn in the same direction as A, because the band is not crossed. In D however the band is crossed, and consequently D turns in the contrary direction to A. At E is shown a pulley with a band over it, reaching round D, and turned by it; showing that a cord may be employed occasionally in turning wheels though they may be in different planes. The velocity of each will be in proportion to their various diameters.

Fig. 17, is called Hooke's universal joint. It is a valuable and simple means of continuing a circular motion with the same rapidity, but in another direction. If the shaft A be turned round so will also the shaft B. This is only available where the angle is more than 140 degrees. If under that, two universal joints must be employed.

— Figs. 18, 19 and 20, are methods by which the direction of motion is altered in various kinds of wheel-work, as we see in clocks, watches, and other small as well as large machinery.

(To be continued.)

THE BRITISH MOSSES.

THESE are none of the cryptogamic plants, with the exception of the Ferns, which have been so much studied as the Mosses. Their exquisitely beautiful structure, extreme minuteness of parts, frequency of occurrence, the barren and bleak character of the places of growth of those most familiar to us, which flourish under exposure that flowering plants cannot sustain; and still more, perhaps, their greeting us in the winter, at a season when all else is lifeless, are circumstances which render this tribe peculiarly interesting, and it may be added, peculiarly instructive. Examine either of them—mark its smooth and undivided, its nerved and pellucid leaf, its exquisitely-formed capsule, crowned at first with a closely-fitting lid; and even that thatched as it were with a hood; or look at the mouth of the same capsule, after its hood and lid have been thrown off; see it surrounded with a single or double star of the most regular and delicately-formed teeth or rays, in number 4, 8, 16, 32, or 64; look at the beautiful ramifications of the branches of some kinds—the fine vivid green of others; and it will be readily admitted, that although the Mosses may not possess such attractive fragrance, or majestic port as flowering plants, nor yet be capable of such generally-useful applications as others are, yet a single glance forces upon us a conviction of their consummate perfection and beauty.

Description.—The root is in all instances fibrous, sometimes branched—at others consisting of a mass of simple filaments. It is said not to be an organ of nutrition, but merely of attachment, an opinion which we think observation will scarcely warrant, especially when it is remembered, that whenever a Moss is separated from its root it withers, in the same circumstances which others not so mutilated continue to grow: and very rarely, if ever, can Mosses be propagated by cuttings, although their removal with a root is easy. The erect growing species have roots only at the extremity of the stem—the creeping kinds, as *Bartramia arcuata*, *Hypnum sericeum*, and numerous others, throw out fibres, (sometimes in dense masses) all along the under surface of the stem, and a few of them even from the apices of their leaves.

The stem has a distinct axis of growth, not composed either of woody fibre or spiral vessels, but merely cellular tissue, compressed so as to be very often hard and tough. The size of the stem is the same throughout, growing only from the point, and producing its leaves simultaneous with its own progress, but not afterward increasing in diameter—though in the branched kinds the branches are by degrees sent off, in equal size to their parent stem. These continue to grow outwards, and to produce other branches in a similar manner. The arrangement of the branches in any species is of a general, but not a particular character. For example, *Hypnum molluscum*, has always a beautifully feathered appearance, but two specimens can never be found exactly alike in the disposition of their ramifications.

The leaves are always sessile, entire, (except in *Buxbaumia aphylla*), or at most serrated, undivided, and perfectly smooth, no hairiness being ever found upon their general surface. The only approach to this being that some leaves have a vein, or nerve as it is called, running from the base towards the point—this nerve often stops before reaching it, but sometimes it extends to a considerable distance be-

yond, when the exerted portion appears like a long hair from the apex of the leaf, and the leaves being so numerous the plant appears hairy. Also, in a very few there are cilia to be discovered around the edges of the leaf. Around the base of the foot-stalk is sometimes a cluster of leaves, very different in shape from the rest. These are called perichæ-tial leaves.

The leaves are certainly the chief organs of absorption. This property arises from, and is a necessary consequence of their loose cellular structure, the cuticle being in the highest degree porous, as is seen by the rapidity with which they are affected by a damp atmosphere. The absorbent nature of the leaves is made evident, experimentally, by inclosing a piece of Moss in a phial, with a few drops of water, and corking it up, when it will remain in a green and apparently healthy state for a very considerable time. This fact may be of use to the botanist, who finding a Moss while its fruit is yet imperfect, is thus enabled to keep it alive and growing, until its fruit may become ripe, or fit for examination.

The re-productive organs.—How the perfection of seed is accomplished in the various cryptogamic plants, is a matter that is, and may ever remain in mystery. All we are enabled to do is to describe the parts which are visible, and found upon them a plausible conjecture of their uses. In the Mosses two different bodies are discoverable. The perichæ-tial leaves give rise sometimes to a long foot-stalk, which supports a capsule bearing true re-productive seeds. In other parts of the same plant, or on another plant of the same species, the perichæ-tial leaves expand somewhat like a rose, (as is seen very commonly in various species of the *Polytrichum*.) A close examination of this part shows the leaves to be intermixed with minute, oblong bodies, supposed by some to be anthers—by others denied that function. It is certain, however, that they are filled with a granular substance, which is discharged from a pore at their apex. The only difficulty that exists in the matter is this—how can this pollen be conveyed to one of the differently-formed flowers, so as to fertilize it?

In different species and genera, instead of the rose-like expansion above spoken of, the anthers, if such they be, are in axillary buds, or collected together in granular heads, which are on pedicels. This latter disposition is seen very conspicuously, and frequently on *Bryum androgynum*, and *Bryum palustre*.

As these bodies are extremely minute, and so very generally buried in the axils of the leaves, appearing only by the aid of a magnifying glass, and at certain seasons of the year, they have been mostly overlooked by the casual observer, and the more easily, because they are not used in the discrimination of Mosses from each other, and therefore have been but little searched for. Sprengel justly observes, that "these minute parts are often not to be found without great difficulty, much depending on the season of the year. The young buds and fruit will, for the most part, be sought for in vain, both in the parching heat of summer, and in the intense frost of winter, but are readily found in spring, after the earth is unbound by the thaw, and in autumn, during the frequent rains and fogs of the season." But in swamps, and on the northern sides of mountains, an attentive observer may often find them even in the midst of summer. There is some difference also in this respect in different genera and

species. They are with more difficulty discovered when concealed within buds, as in the species of *Hypnum*, *Leskea*, and *Neckera*, than when seen in disk or star-shaped expansions, and sometimes even surrounded by differently-colored leaves, as is the case in *Polytrichum*, *Funaria*, *Bryum*, *Gymnostomum*, *Splachnum*; or when appearing in pedicelled heads, as in *Tetraphis*, *Sphagnum*, *Bryum androgynum*, and some others."

The second kind of re-productive organs, appertaining to the Mosses, is that part commonly known as the fruit. In an early state there are found hidden among the perichæ-tial leaves, either attended by or distinct from the gemmæ or anthers before alluded to—various long, narrow, pitcher-shaped bodies, called germs—and which are covered at this period by a membranous sheath. In *Schistostæga*, the germ is solitary—in other species there are from two or three to twelve, though not often exceeding six. Seldom more than one of these comes to perfection—thus, for the most part, the fruit of the Mosses is solitary. There are, however, occasional exceptions as in *Bryum roseum*, *ligulatum*, and a very few others. The upper part of the germ is in its young state perforated throughout with a single pore, and is furnished with a somewhat thickened extremity, therefore called the stigma and style, from its supposed analogy with those parts in perfect plants. After a time the germ swells, the membrane which at first covered it becomes torn at the base, so as to be detached from the other parts, though not as yet thrown off. The separation takes place in consequence of the stalk which supports the germ elongating, and of course bearing upwards every part attached or belonging to it. As maturity approaches, the capsule swells—its stalk still lengthens—its sheath, now called a *calyptra*, falls away—in some cases merely pushed upwards by the pressure of the expanding capsule within it, without any other laceration than that which it first received, when it would be called *torn*, if divided regularly; or *mitriform*, if by a regular transverse section—while if the *calyptra* should become split along one side, as is often the case, it is said to be *dimidiate*. The fruit-stalk, which is sometimes straight, at others bent, and often hygrometrical, is in the generality of the species joined immediately to the capsule, though instances occur, as for example *Splachnum*, where a peculiar knob or lump is discoverable under the capsule. This is called the *apophysis*. It is so large and long in some species, as to resemble a second stalk. This is the case throughout the genera *Enthostomum* and *Sphagnum*. The capsule is either globular, cylindrical, or angled—either of even surface, or in some cases beautifully ribbed. It is only in an early stage that the capsule is seen closed at the top, except in the genus *Phascum*, (and also *Andrea*), for the upper part soon breaks off transversely, like the cover of a vessel, therefore called the *lid*. When this is broken away, the mouth of the capsule is seen in the instance of *Gymnostomum*, &c., to be entirely open. In other genera furnished with one or two rows of teeth, either equally distant or united in pairs, and variously torn, perforated, twisted, curved, or jointed—generally with a degree of regularity and beauty, beyond what not having observed them we might suppose impossible. It has been before observed, that these teeth are always in number 4, 8, 16, 32, or 64, and never of any intervening number. Those of the outer row are rigid, and proceed from the outer membrane which lines the capsule, while an in-

ner and more delicate membrane produces the inner row of teeth. The centre of the capsule is occupied by a column, called the *columnella*, to which the seeds are partially attached, in certain species without any peculiar envelopment—in a few others the seeds are contained in long transparent pipes or bags. They are scattered by the capsule shrivelling towards the lower part, and thus squeezing the seeds over the mouth of it.

It should have been observed, that both the germs and gemmæ are surrounded and intermixed with succulent hair-like filaments, the use of which is entirely unknown.

(To be continued.)

WARM BATHS.

WARM baths have lately come into very general use, and they are justly considered as indispensably necessary in all modern houses of any magnitude, as also in club-houses, hotels, and hospitals. But the mode of constructing these baths, and of obtaining the necessary supplies of hot and cold water, does not appear to have undergone an improvement equal to the extension of their employment. The several points in regard to warm baths, are,

1. The materials of which they are constructed.
2. Their situation.
3. The supply of cold water.
4. The supply of hot water.
5. Minor comforts and conveniences.

1. As to the materials of which they are constructed.—Of these the best are slabs of polished marble, properly bedded with good water-tight cement, in a seasoned wooden case, and neatly and carefully united at their respective edges. These, when originally well constructed, form a durable, pleasant, and agreeable-looking bath; but the expense is often objectionable, and, in upper chambers, the weight may prove inconvenient. If of white or veined marble, they are also apt to get yellow or discolored by frequent use, and cannot easily be cleansed; so that large Dutch tiles, as they are called, or square pieces of white earthenware, are sometimes substituted; which, however, are with difficulty kept water-tight; so that, upon the whole, marble is preferable. Where there are reasons for excluding marble, copper or tinned iron plate is the usual material resorted to. The former is most expensive in the outfit, but far more durable than the latter, which is, moreover, liable to leakage at the joints, unless most carefully made. Either one or the other should be well covered outside and inside, with several coats of paint, which may then be marbled, or otherwise ornamented. Wooden tubs, square or oblong, and oval, are sometimes used for warm baths; and are cheap and convenient, but neither elegant nor cleanly. The wood always contracts a mouldy smell; and the difficulty and nuisance of keeping them water-tight, and preventing shrinkage, are such as to exclude them from all except extemporaneous application.

2. As to the situation of the bath, or the part of the house in which it is to be placed.—In hotels, and club-houses, this a question easily determined: several baths are usually here required, and each should have annexed to it, a properly warmed dressing-room. Whether they are up stairs or down stairs, is a question of convenience, but the basement-story, in which they are sometimes placed, should always be avoided; there is a coldness and dampness belonging to it, in almost all weathers, which is

neither agreeable nor salubrious. In private houses, the fittest places for warm baths are dressing-rooms annexed to the principal bed-rooms; or, where such convenience cannot be obtained, a separate bath-room, connected with the dressing-room, and always upon the bed-room floor. All newly-built houses should be properly arranged for this purpose, and due attention should be paid to the warming of the bath-room, which ought also to be properly ventilated. A temperature of 70° may be easily kept up in it, and sufficient ventilation is absolutely requisite, to prevent the deposition of moisture upon the walls and furniture. The objection which formerly prevailed, in respect to the difficulty of obtaining adequate supplies of water, in the upper rooms, has been entirely obviated, by having cisterns at or near the top of the house; and we would just hint that these should be so contrived, as to be placed out of the reach of frost; a provision of the utmost importance in every point of view, and very easily effected in a newly-built house, though it unfortunately happens, that architects usually regard these matters as trifles, and treat them with neglect, as indeed they do the warming and ventilation of buildings generally.

3. The supply of water of proper quality and quantity is a very important point, as connected with the present subject. The water should be soft, clean, and pure; and as free as possible from all substances mechanically suspended in it. In many cases, it answers to dig a well for the exclusive supply of a large house with water. The hot water should enter the bath by a pipe at least an inch and a half in diameter; and the cold water by one of the same dimension, or somewhat larger, so that the bath may not be long in filling. The relative proportions of the hot and cold water, are, of course, to be adjusted by a thermometer, and every bath should have a two-inch waste-pipe, opening about two inches from the top of the bath, and suffering the excess of water freely to run off; so that when a person is immersed in the bath, or when the supplies of water are accidentally left open, there may be no danger of an overflow. Where there is a laundry in the upper story of the house, or other convenient place for erecting a copper and its appurtenances, a plan similar to the above may often be conveniently adopted in private houses, for the supply of a bath upon the principal bed-room floor. An attempt is sometimes made to place boilers behind the fires of dressing-rooms, or otherwise to erect them in the room itself, for the purpose of supplying warm water; but this plan is always objectionable, from the complexity of the means by which the supply of water is furnished to the boiler, and often dangerous from the flues becoming choked with soot, and taking fire. Steam is also apt, in such cases, to escape in quantities into the room; so that it becomes necessary to search for other methods of heating the bath; one or two of the least objectionable of which we shall describe.

1. A contrivance of some ingenuity consists in suffering the water for the supply of the bath to flow from a cistern above it, through a leaden pipe of about one inch diameter, which is conducted into the kitchen or other convenient place, where a large boiler for the supply of hot water is required. The bath-pipe is immersed in this boiler; in which it makes many convolutions, and, again emerging, ascends to the bath. The operation is simply this:—The cold water passing through the convolutions of that of the pipe which is immersed in the boiling

water, receives there sufficient heat for the purpose required, and is delivered in that state by the ascending pipe in the bath, which is also supplied with cold water and waste-pipes as usual. The pipe may be of lead, as far as the descending and ascending parts are concerned, but the portion forming the worm, or convolutions immersed in the boiler should be copper, in order that the water within it may receive heat without impediment. This plan is economical only where a large boiler is constantly kept at work in the lower part of the house; otherwise, the trouble and expense of heating such a boiler, for the mere purpose of the bath, render it unavailable. The worm-pipe is also apt to become furred upon the outside, by the deposition of the earthy impurities of the water in which it is immersed; it then becomes a bad conductor of heat, is cleansed with difficulty, and the plan is rendered ineffective. This system, however, has been adopted, in some particular cases, with satisfaction.

2. A much more simple, economical, and independent mode of heating a warm bath, by a fire placed at a distance from it, is the following, which is found to answer perfectly in private houses, as well as upon a more extended scale in large establishments. It is certainly open to some objections, but these are overbalanced by its advantages. A waggon-shaped boiler, holding about six gallons of water, is properly placed over a small furnace, in any convenient and safe part of the house, as the kitchen, scullery, servants' hall, or wash-house. The bath itself, of the usual dimensions and construction, is placed where it is wanted, with a due supply of cold water from above. Two pipes issue from within an inch of the bottom of the bath at its opposite extremities; one at the head of the bath, about 1 inch, and the other at the foot, an inch and $\frac{1}{2}$ in diameter. These tubes descend to the boiler, the smaller one entering it at the bottom, and the larger one issuing from its top.

Under these circumstances, supposing the pipes and boiler every where perfectly tight, when the bath is filled, the water will descend into and expel the air from the boiler, and completely fill it. Now, upon making a gentle fire under the boiler, an ascending current of warm water will necessarily pass upwards through the larger pipe which issues from its top, and cold water will descend by the pipe which enters at the bottom; and thus, by the establishment of currents, the whole mass of water in the bath will become heated to the desired point; or, if above it, the temperature may easily be lowered by the admixture of cold water.

The advantages of this form of bath are numerous. The shorter the pipes of communication the better, but they may extend 40 or 50 feet without any inconvenience beyond that of expense; so that there is no obstacle to the bath being near the bed room, while the boiler is on the basement story. There is but little time required for heating the bath; the water in which may, if requisite, be raised to about 100° in about half an hour from the time of lighting the fire. The following are the chief disadvantages attendant upon this plan, and the means of obviating them:—It is necessary, when the water has acquired its proper temperature, to withdraw the fire from the boiler, or not to use the bath immediately, as it may go on acquiring some heat from the boiler, so that we may become inconveniently hot in the bath. When therefore this bath is used, we may proceed as follows:—heat the water in it an hour before it is wanted, to about 100° and then extinguish the

fire. The water will retain its temperature, or nearly so, for three or four hours, especially if the bath be shut up with a cover; so that when about to use it, cold water may be admitted till the temperature is lowered to the required point, and thus all the above inconveniences are avoided.

Many copper and tin baths have been lately constructed in London, with a little furnace attached to one end, and surrounded with a case or jacket, into which the water flows and circulates backwards and forwards till the whole mass in the bath gets heated to the due degree. The bath must be placed near the fire-grate, and the smoke-pipe of the attached furnace be conducted up the chimney a certain way to secure a sufficient draught to maintain combustion. The above bath, well managed, heats the water from 50° to 98° in about 20 or 25 minutes. When the proper temperature is attained, the fire must of course be extinguished.

MANAGEMENT OF FOREIGN WINES.

ON wines being landed, the less they are exposed the better, for they are affected by the seasons, and more or less by the climate. March and April are the times for shipping wines from France, and they will be landed, in England and Ireland, in the same degree of temperature. The great art in keeping wines is to prevent their fretting, which is done by keeping them in the same degree of heat. In spring and fall, the wines in Bordeaux are subject to changes that may be dangerous, if not prevented by necessary rackings; these changes are solely the effect of the seasons. If wines be chilled, and of course turned foul, from being shipped and landed in cold weather, they will soon recover, by putting them in a warm vault, well covered with sawdust. As soon as they are in the vault they ought to be covered up; but, if shipped and landed in summer, if the smallest degree of fermentation be found on them, it will be necessary to dip the bung clothes in brandy, and leave the bungs loose for some days, to give time to cool; and, if in a fortnight or three weeks the fermentation do not cease, and the wine become bright, it will be proper to rack it, (mashing the hogsheads well with brimstone,) and force it with the white of eight eggs. If it then become fine, bung it tight, and let it remain so until bottled. If wines new landed are wanted soon for the bottle, it will be necessary to force them immediately, and let them remain bunged close for at least a month, to recover from the forcing, or if two months the better; for wines bottled in high order come much sooner into drinking than if bottled when flat, which all wines are after forcing. Wine must never be bottled the least foul, which produces a tendency to fret, and, if bottled in this state, will never come in order, but may possibly be lost: for this there is no remedy but repeated rackings; and care must be taken, (after rinsing the hogsheads well and drawing them,) to burn a good piece of match in them. This cools the wine, and there is no danger of hurting the color, for it recovers in a little time; but, if it even do hurt the color, it is absolutely necessary; for wine suffered to continue on the fret will wear itself to nothing. Wines bottled in good order may be fit to drink in six months; but they are not in perfection before twelve: from that to two years they may continue so; but it would be improper (with some few exceptions) to keep them longer, for wines in general have not the body they had formerly, from the vines being too much forced.

Tasting tests the variety and quality of wines. It is impossible to lay down certain rules for tasting wines: custom, and custom alone, gives the palate that exquisite sense of perception which forms the basis of the art. It is scarcely necessary to observe that wine is seldom pure, unless bought when drawn from the cellar; that it is always more or less adulterated; that it should possess a color in relation with its quality, and a just degree of spirit. If the spirit of wine be diminished, the color experiences a proportionate alteration. Wine of a rough and tart taste should not always be rejected, since it often becomes good as it grows old. Almost even in new wine, which is pure, these two symptoms of roughness and tartness concur, and they prove that no adulteration has been used to soften the beverage.

It is well known to be a common practice among dealers in wines to adulterate bad wine to conceal its defects; if, for instance, the wine be sour, they throw into it a quantity of sugar of lead, which entirely takes away the sour taste. For similar purposes alum is often mixed with wine. Such substances, however, are well known to be extremely pernicious to the human constitution. To discover lead dissolved in wine, take equal parts of calcined oyster shells, and crude-sulphur in fine powder, and put them in a crucible, which put into the fire, and raise the heat suddenly till it has been exposed to a white heat for fifteen minutes; then take it out, let it cool, beat the ingredients to powder, and put them into a well corked bottle. To prepare the best liquor, put twenty grains of this powder, together with 120 grains of cream of tartar, and put them into a strong bottle, fill it up with water, boil it for an hour and let it cool, cork the bottle immediately, and shake it from time to time. After some hours repose decant off the clear liquor into an ounce phial, having first put twenty-two drops of muriatic acid into each phial. Cork these phials accurately with a little wax mixed up with a little turpentine. One part of this liquor, mixed with three parts of suspected wine, will discover the smallest quantity of lead, or copper, by a very sensible black precipitate, and of arsenic, by an orange precipitate, but will have no effect on iron if there be any; the presence of which, however, may be ascertained by adding a little potash, which will turn the liquor black if there be any iron. Pure wine remains limpid after the addition of this liquor. To know whether any wine contains alum or not, we have only to mix a small quantity of it with lime water: if crystals be formed, it contains no alum; if not, it does. ●

Bottles should be selected of good manufacture, and of equal diameter throughout, or they will be liable to break in the bin, when piled high. Twenty-four hours, at least, before they are filled the bottles should be cleaned and rinsed. Shot should never be used, for the acid of the wine is apt to act upon such as are left jammed in the hollow of the bottoms. Clean gravel is better, or a small iron chain, the links minute, and yet as loose as they can be procured. The bottles should then be reversed to drain in planks, having holes for the necks. Afterwards they should be rinsed in a little brandy, if the wine to be bottled be weak and of small body; letting them drain as with the water, but not until quite dry. Very fine wines are injured by the brandy, and for them this process must not be used. The corks must be sound, well cut, perfectly new, supple, and without the remains of bark upon them. The corks should be driven home by a wooden mallet. Bottles

should be waxed, or rather stopped with a composition on the tops, and also the surrounding glass, to prevent any air passing between that and the corks. When the bottles are corked and waxed, they should be placed in a perfect horizontal position so that the cork be always in contact with the liquid. The soil on which the bottles lie should be first beaten very firm. Laths may be placed between each tier of bottles, and a bed of sand should lie in the interstices in each tier. Piles a yard high, the ends of the piles confined by wooden posts, are better situated than when the bottles are placed touching the cellar walls or in bins. The rich wines *de liqueur*, such as Malaga, Syracuse, Alicante, and others, may be placed on their ends; but the dry wines must be arranged in the horizontal position.

SHINING OF THE EYES OF THE CAT, &c.

EVERY body knows that the eyes of the cat shine in the dark. Our domestic cats afford us so frequent opportunities of observing this phenomenon, that it seems peculiar to them; but there are several other animals which equally present it, as the dog, the sheep, the cow, the horse, the polecat, and even several serpents, and some insects, among others in the species of sphynx, commonly known by the name of the death's head moth.

Buffon says, that "the eyes of the cat shine in the dark somewhat like diamonds, which throw out, during the night, the light with which they were, in a manner, impregnated during the day." Va'mont de Bismare says, that "the pupil of the cat is during the night still deeply imbued with the light of the day," and some lines lower he adds, "the eyes of the cat are during the night so imbued with light, that they then appear very shining and luminous." Spallanzani says, that "the eyes of cats, polecats, and several other animals, shine in the dark like two small tapers, and that this light is phosphoric." M. Dessaignes, in his memoir on phosphorescence, which was crowned by the Institute on the 5th of April, 1809, says, that "the eyes of certain animals have the faculty of inflaming, and of appearing like a fire in the dark." ● ●

It is quite certain that neither Buffon, nor Spallanzani, nor M. Dessaignes, ever observed on purpose the shining of the eyes of the cat, and that they never saw this phenomenon otherwise than cursorily, as one sees when he does not attend to a thing, or when one only partially attends to it; otherwise they would immediately have perceived that the eyes of cats never shine in intense darkness, and that it is sufficient for them, to shine, that too great a light does not prevent the pupil of the animal from dilating much; that, in reality, the phenomenon is only sensible to the observer, when his eye receives little light from surrounding objects. The case, then, is the same with the eye which shines, as with the light which the pictures of a panorama reflect, and which appears to have all the intensity of that of the objects which they represent, although much inferior to it.

The less light the eye of the observer receives, the more is it sensible to that which the eye of the cat projects, and the less need has the latter of receiving any; it must receive more to produce an equal effect, if the former be situated in a lighter place. These are the conditions of the phenomenon. They appear to reduce this pretended phosphorescence to light reflected by a shining object.

Valmont de Bomare, in the article *Chat* of his *Dictionnaire*, (the edition in fifteen volumes,) says, after what we have already quoted, "it seems that the lustre, the splendour, which is observed in the day time in the eyes of the cat, comes from the shining part of the retina, at the place where it surrounds the optic nerve." This does not agree very well with what precedes: for in full day-light the retina of the cat is not visible, and if he means to speak of the lustre that is visible in a weak light, it is certainly of the same nature as that which is observed in darkness, and which Valmont de Bomare attributes to the imbibing of the light of day. Nor does this author speak here from his own observation: what he says of the eyes of the cat is taken almost word for word from Buffon's works, and from the first edition of the *Encyclopédie*. We also find in the Geneva edition of thirty-nine volumes, 4to., article *Chat*, the following words:—"It appears that the lustre, the shining, the splendour, which are observed in the eyes of the cat, come from a sort of velvet, which lines the bottom of the eye, or from the shining of the retina at the place where it surrounds the optic nerve." The phenomenon can be imitated with all its peculiarities, by placing bits of tinsel under suitable circumstances, or by other similar means. It is not, therefore, necessary, to have recourse to phosphorescence for an explanation of it. It is certain enough, that a great number of substances become luminous in the dark, after having been exposed some moments to the light of the sun, or only to the ordinary day-light, or to the light of a lamp, or of the moon. But it is not probable that the eyes of the cat are of this class; for, like those of other animals, they are filled with various humours; and there results from M. Dessaigne's experiments, that neither the fluids nor the substances which have imbibed them manifest this property. Besides, the eyes of the cat do not shine either in absolute darkness, or even in a very intense although imperfect darkness. A certain degree of light is always requisite, which may, indeed, be very feeble, but still quite perceptible.

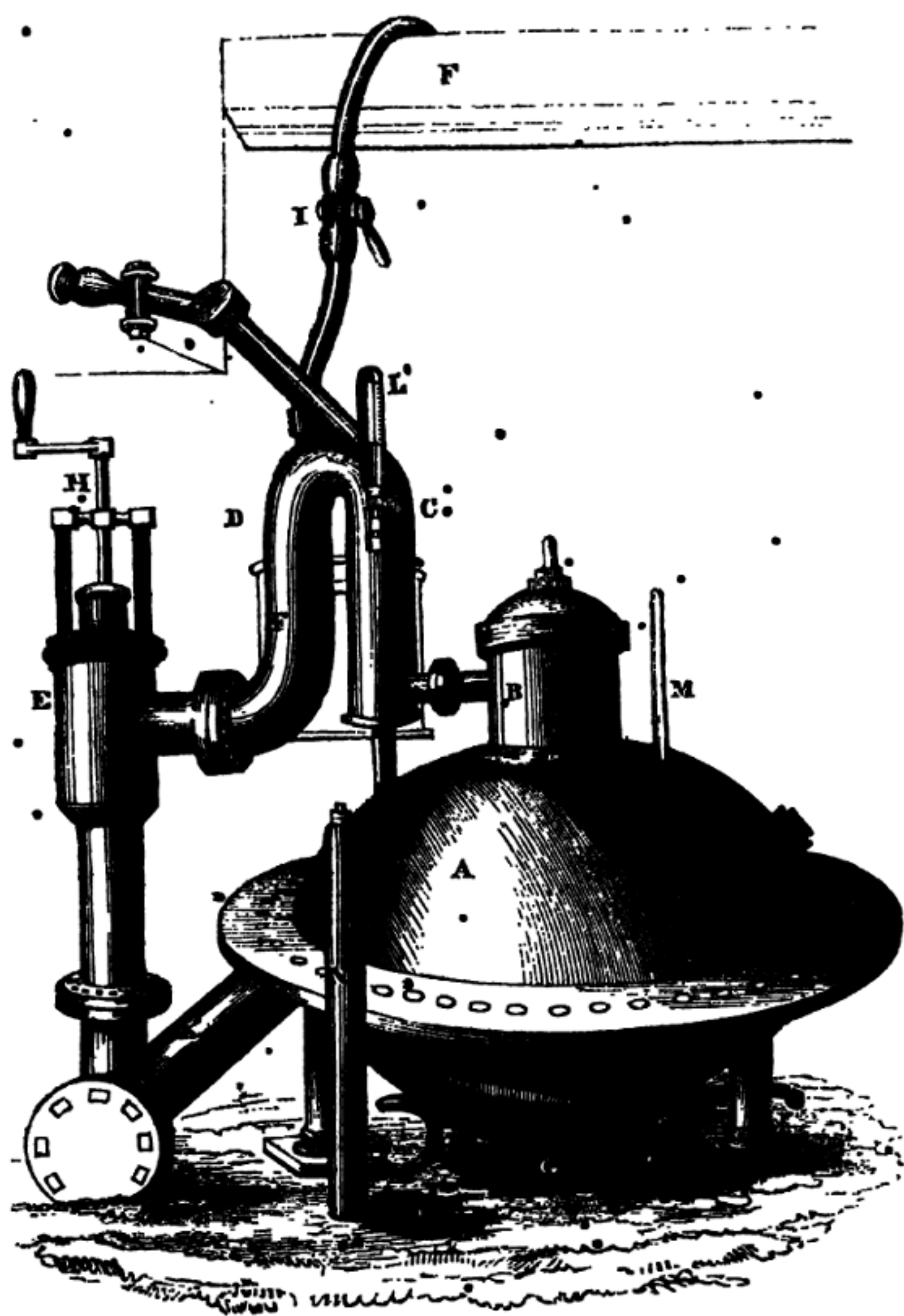
It is known that "the inner layer of the choroid coat, which appears to be of a firmer texture than the rest of its thickness, and which bears the name of *Ruyischian membrane*, is lined in man and in several other animals, with a blackish, or even absolutely black and dull mucosity, which may be detached or wiped off with the finger or a pencil, and which serves to prevent the rays reflected by the internal walls of the eye from disturbing the vision. Now, the bottom of the *Ruyischian membrane* is only covered with a layer of that varnish, through which its color, which varies in a singular degree, according to the species, is perceived. In man, and the monkey tribe, it is brown or blackish; in hares, rabbits, and hogs, of a chocolate brown; but most of the carnivora, the ruminantia, the pachydermata, the solipeda, and the cetacea, have bright and shining colors in this part. The ox has it of a beautiful gold green, changing into sky-blue; the horse, the goat, the buffalo, the deer, of a silvery blue, changing into violet; the sheep of a pale gold green, sometimes bluish; the lion, the cat, the bear, and the dolphin, have it of a pale gold yellow; the dog, the wolf, and the badger of a pure white, edged with blue. This colored part of the *Ruyischian membrane* is named the *tapis*.

It is astonishing that M. Cuvier, after this description, does not say a word of the phenomenon; but this celebrated anatomist, whose genius knows to subject itself to the laws of a rigorous accuracy, not having probably observed it himself with sufficient care, has rather chosen to say nothing, than to repeat the opinions of others respecting a subject, which, at bottom, belongs much less to anatomy than to natural history.

M. Dessaignes not only says that the eyes of certain animals kindle and appear as on fire in the dark: but, according to him, they owe this faculty to the expansive effect of the lively passions with which the animal is affected. But he is certainly deceived, or at least this is subject to numerous exceptions.

It was not enough to consider the shining of the eyes as phosphoric; it has also been pretended that it serves as a light to the animals which possess it, and that it assists them in seeing and guiding themselves in the dark. But the place which the reflectors occupy is reasonably a matter of astonishment, for it is not the light which proceeds from the eye to an object that enables the eye to perceive that object, but the light which arrives in the eye from it. Spallanzani thought that cats, polecats, and some other animals, move with promptitude and certainty in a medium totally deprived of light, and this is also a subject of pretty general belief. But the truth of it is very doubtful. But should this really be the case, it ought not to be attributed to the shining of their eyes, since this aid, as we have seen, fails them when they have most need of it. Animals in the state of nature are never placed in such circumstances. Nor is it even probable that such an occurrence takes place in a state of domesticity. In whatever part they may happen to be, there is always a little light, and in order to see, they only require to have their pupil susceptible of great dilatation, and their retina of an extreme sensibility. It is said that a man shut up for a long time in a very dark dungeon becomes at length able to read. The nocturnal birds which Spallanzani reared, saw very well in a place in which he himself could distinguish no object, and he admits that the eyes of these birds do not shine in the dark. Besides sheep, cows, horses, and several other animals which have the eyes shining, would, no doubt, find themselves much embarrassed in absolute darkness. If some quadrupeds, in fact, move with promptitude and security in complete darkness, it is certainly not to their eyes that they are indebted for it, but to some other sense. The bats, in which Spallanzani discovered this faculty, owe it, according to him, to a sixth sense, of which we have no idea; and, according to Cuvier, to the extent of the membrane which their wing presents to the air, and which renders it capable of feeling its resistance, motion, and temperature.

The preceding observations seem sufficiently to prove, 1st. That the shining of the eyes of the cat and of other animals, which present the same phenomenon, does not arise from a phosphoric light but only from a reflected light; that, consequently 2d. It is not by an effect of the will of the animal or by that of certain passions, that this light emanates from its eyes; 3d. That this shining does not manifest itself in absolute or too profound darkness 4th. That it cannot enable the animal to move with security in the dark.



MANUFACTURE AND REFINEMENT OF SUGAR.

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CANE-JUICE varies exceedingly in richness, with the nature of the soil, the culture, the season, and variety of the plant. It is an opaque fluid, of a dull grey, olive, or olive-green color; in taste balmy and saccharine; exhaling the balsamic odour of the cane, slightly viscid, and of a specific gravity varying from 1.033 to 1.106, according to circumstances. When fresh, it consists of two parts; the one liquid, the other solid; the latter of which being merely suspended in the former, and therefore separable in a great measure by filtration or repose. The solid matter consists of fragments of the cellular parenchyma of the cane, its fibres and bark, mechanically protruded through the mill, mixed with a very abundant greenish substance.

When left to itself in the colonial climates, the juice runs rapidly into the acetous fermentation; twenty minutes being in many cases sufficient to bring on this destructive change. Hence arises the necessity of subjecting it immediately to clarifying processes speedy in their action. When deprived of its green fecula and glutinous extractive, it is still subject to fermentation: but this is now of the vinous kind. The juice flows from the mill through a wooden gutter lined with lead, and being conducted into the sugar-house, is received in a set of large pans or caldrons, called clarifiers. On estates which make on an average during crop time, from 15 to 20 hogsheads of sugar a week, three clarifiers, of from 300 to 400 gallons capacity each are sufficient. With pans of this dimension, the liquor may be drawn off at once by a stopcock or syphon, without disturbing the feculencies after they subside. Each clarifier is hung over a separate fire, the flue being furnished with a damper for checking the combustion, or extinguishing it altogether. The clarifiers are sometimes placed at one end, and sometimes in the middle of the house, particularly if it possesses a double set of evaporating pans.

Whenever the stream from the mill cistern has filled the clarifier with fresh juice, the fire is lighted, and the *temper*, or dose of slaked lime, diffused uniformly through a little juice, is added. If an albuminous emulsion be used to promote the clarifying, very little lime will be required; for recent cane-liquor contains no appreciable portion of acid to be saturated. In fact, the lime and alkalies in general, when used in small quantity, seem to coagulate the glutinous extractive matter of the juice, and thus tend to brighten it up. But if an excess of temper be used, the gluten is taken up again by the strong affinity which is known to exist between sugar and lime. Excess of lime may always be corrected by a little alum-water. Where canes grow on a calcareous marly soil, in a favorable season the saccharine matter gets so thoroughly elaborated, and the glutinous mucilage so completely condensed, that a clear juice and a fine sugar may be obtained without the use of lime. As the liquor grows hot in the clarifier, a scum is thrown up, consisting of the coagulated feculencies of the cane-juice. The fire is now gradually urged till the temperature approaches the boiling point, to which, however, it must not be suffered to rise. It is known to be sufficiently heated, when the scum rises in blisters, which break into white froth; an appearance observable in about forty minutes after kindling the fire. The damper being shut down, the fire dies out, and after an hour's repose, the clarified liquor

is ready to be drawn off into the last and largest in the series of evaporating pans. In the British colonies, these are merely numbered 1, 2, 3, 4, 5, beginning at the smallest, which hangs right over the fire, and is called the *teache*; because in it the trial of the syrup, by *touch*, is made. The flame and smoke proceed in a straight line along a flue to the chimney-stalk at the other end of the furnace. The area of this flue proceeds, with a slight ascent from the fire, to the aperture at the bottom of the chimney; so that between the surface of the grate and the bottom of the *teache* there is a distance of 28 inches; while between the bottom of the flue and that of the *grand* No. 5, at the other end of the range, there are barely 18 inches.

In some sugar-houses there is planted, in the angular space between each boiler, a basin, 1 foot wide and a few inches deep, for the purpose of receiving the scum which thence flows off into the *grand copper*, along a gutter, scooped out on the margin of the brickwork. The skimmings of the *grand* are thrown into a separate pan, placed at its side. A large cylindrical cooler, about 6 feet wide and 2 feet deep, has been placed in certain sugar-works near the *teache*, for receiving successive charges of its inspissated syrup. Each finished charge is called a *skipping*, because it is skipped or laded out. The term *striking* is also applied to the act of emptying the *teache*. When upon one skipping of syrup in a state of incipient granulation in the cooler, a second skipping is poured, this second congeries of saccharine particles agglomerates round the first as *nuclei* of crystallization, and produces a larger grain, a result improved by each successive skipping. This principle has been long known to the chemist, but does not seem to have been always properly considered or appreciated by the sugar-planter.

From the above described cooler, the syrup is transferred into wooden chests or boxes, open at top, and of a rectangular shape; also called *coolers*, but which are more properly crystallizers or granulators. These are commonly six in number, each being about 1 foot deep, 7 feet long, and 5 or 6 feet wide. When filled, such a mass is collected, as to favor slow cooling, and consequent large-grained crystallization. If these boxes be too shallow, the grain is exceedingly injured, as may be easily shown by pouring some of the same syrup on a small tray, when, on cooling, the sugar will appear like a muddy soft sand. The criterion by which the negro boilers judge of the due concentration of the syrup in the *teache*, is difficult to describe, and depends almost entirely on the sagacity and experience of the individual. Some of them judge by the appearance of the incipient grain on the back of the cooling ladle; but most decide by "*the touch*," that is, the feel and appearance of a drop of the syrup pressed and then drawn into a thread between the thumb and fore-finger. The thread eventually breaks at a certain limit of extension, shrinking from the thumb to the suspended finger, in lengths somewhat proportional to the inspissation of the syrup. But the appearance of granulation in the thread must also be considered; for a viscid and damaged syrup may give a long enough thread, and yet yield almost no crystalline grains when cooled. Tenacity and granular aspect must therefore be both taken into the account, and will continue to constitute the practical guides to the negro boiler, till a less barbarous mode of concentrating cane-juice be substituted for the present *naked teaché*, or *sugar frying-pan*.

The colonial *curing-house* is a capacious building, of which the earthen floor is excavated to form the molasses reservoir. This is lined with sheet lead, boards, tarra, or other retentive cement; its bottom slopes a little, and it is partially covered by an open massive frame of joist-work, on which the potting casks are set upright. These are merely empty sugar hogsheads, without headings, having 8 or 10 holes bored in their bottoms, through each of which the stalk of a plantain leaf is stuck, so as to protrude downwards 6 or 8 inches below the level of the joists, and to rise above the top of the cask. The act of transferring the crude concrete sugar from the crystallizers into these hogsheads is called potting. The bottom holes, and the spongy stalks stuck in them, allow the molasses to drain slowly downwards into the sunk cistern. In the common mode of procedure, sugar of average quality is kept from 3 to 4 weeks in the curing-house; that which is soft-grained and glutinous must remain 5 or 6 weeks. The curing-house should be close and warm, to favor the liquefaction and drainage of the viscid caramel.

Raw, or muscovado sugar, as imported from the colonies, is contaminated more or less with gluten, lime, but particularly *caramel*, which give its grains a yellow brown tint, an empyreumatic odour, and a soft clammy feel in the hand. If such sugar be dissolved in water, and the syrup be evaporated by a gentle heat, it will afford a sugar of still inferior quality and appearance. This rapid deterioration is in some measure owing to the injurious operation of a prolonged heat upon the crystalline structure, but chiefly to the chemical reaction of the glutinous ferment and lime upon the sugar. The first care of the refiner should therefore be the immediate abstraction of these noxious alteratives, which he effects by the process called *meltings*, that is, mixing up the sugar in a pan with hot water or steam into a pap, and transferring this pap into large sugar-moulds. Whenever these become cool, their points are unplugged, and they are set to drain for a few days in a warm apartment. Sugar thus cleansed is well prepared for the next refining process; which consists in putting it into a large square copper cistern, along with some lime-water, (a little bullock's blood,) and from 5 to 20 per cent. of bone black, and blowing it up with steam; or, in other words, injecting steam through the mixture from numerous orifices in copper pipes laid along the bottom and sides of the vessel. Under the influence of the heat and agitation thus occasioned, the saccharine matter is perfectly dissolved and incorporated with the albumen of the blood and the bone black. Instead of the blood, many of the refiners employ a mixture of gelatinous alumina and gypsum, called *finings*, prepared by adding a solution of alum to a body of lime-water, collecting, washing, and draining the precipitate upon a filter. Other refiners use both the blood and finings with advantage. Bone black is now very frequently employed by the sugar-refiner, not in a fine meal, but in a granular state, like corned gunpowder, for the purpose of decoloring his syrups; in which case, he places it in a box, in a stratum 8 or 10 inches thick, and makes the syrup percolate downwards through it, into a cistern placed beneath. By this means it is deprived of color, and forms the *clarice* of the French refiner. When the blowing up cistern is charged with sugar, finely ground bone black, and blood, the mixture must be passed through a proper system of filters.

The next process in sugar-refining is the evapora-

tion of the clarified syrup to the granulating or crystallizing pitch. The more rapidly this is effected, and with the less scorching injury from fire, the better and greater is the product in sugar-loaves. No apparatus answers the refiner's double purpose of safety and expedition so well as the vacuum-pan of Howard.

The cut shows the structure of a single vacuum-pan. The horizontal diameter of the copper spheroid A is not less than 5 feet: the depth of the under hemisphere is at least 18 inches from the level of the plane; and the height of the dome-cover is 2 feet. The two hemispheres (of which the inferior one is double, or has a steam-jacket,) are put together by bolts and screws, with packing between the flanges to preserve the joints tight against atmospheric pressure. The jacket of the lower hemisphere forms the case of the steam, which communicates heat to the syrup inclosed in the inner hemisphere. In general the pans contain, when filled to the flange, 100 gallons of syrup, and yield about 11 cwt. of granulated sugar at every charge.

A, represents the vacuum spheroid; B, the neck with the lid. From the side of B, a pipe passes into the lower extremity of the bent pipe C D, which terminates in the vertical pipe E, connected with the vacuum main-pipe K, proceeding horizontally from the air-pump (not shown in the figure). At the top of E, a valve, movable by a screw H, is placed for establishing or cutting off the connexion with the air-pump at pleasure. Behind F, is the measure cistern, from which the successive charges are admitted into the pan. This measure is filled with the clear syrup, by opening the stopcock I, on the pipe under the ceiling, which communicates with the filter-cistern placed above. G is the valve or plug-hole, at the bottom of the pan, for discharging the granulating syrup. This plug is opened by means of a powerful lever attached to it; the connexion with the air-pump being previously intercepted. L, is the barometer or manometer, for showing the state of the vacuum corresponding to the temperature. N N, is a cistern-pipe for receiving any little syrup which may accidentally boil over the neck B. Its contents are let off by a stopcock at its bottom from time to time. M shows the place of the *proof-stick*, an ingenious brass rod for taking out a sample of syrup without admitting air.

The charging-cistern contains about 20 gallons. This quantity of syrup being first admitted, and brought to a certain pitch of concentration, a second measure is introduced, the inspissation of which is supposed by some refiners to cause an agglomeration of saccharine matter round the first crystalline particles. The repetition of this process for two or three times is imagined to produce the large brilliant grain of vacuum-pan sugar. This hypothesis is more specious than sound, because the granulating syrup discharged from the pan is subjected to a heat of 180° or 190° in the subjacent steam-cased receiver, whereby the granulations are again reduced to a very small size. Into this receiver, two or three skippings or discharges of the pan are admitted in succession, and the whole are diligently mixed and agitated by a stirring oar. It is by this process that the granulating tendency is promoted and determined. From this receiver (absurdly enough called a cooler) the moulds are filled in the usual way, by means of copper basins or large ladles.

The case of the under hemisphere of the vacuum-pan is filled with steam, generated under a pressure of four or five pounds on the square inch; the heat

of which causes the inferior syrup to boil rapidly while the air-pump is kept in action. A small escape-pipe for waste steam must be placed at the opposite side of the case or jacket, to ensure its equal distribution; as also a stopcock below to let off the water of condensation. The pans are mounted on iron feet or short pillars, which insulate them from the floor, and allow their whole surface to be inspected, and any flaw to be repaired. The air-pump usually stands in a cold-water cistern, to favor the condensation of the aqueous vapor, which it draws out of the pans; and it is kept in constant action by the steam-engine, being attached to the working-beam of its piston.

The vacuum-pan was originally heated solely by the admission of steam between the double bottom; but of late years the heat has been also applied to the syrup through several coils of pipe placed within the pan, filled with steam at a temperature many degrees above 212° F., sometimes so high as 250° . By this double application of heat, the evaporating power of a pan has been vastly increased. The latest made pans have a considerably flat bottom, a spiral pipe laid close upon it; and between the hemisphere and the upper one, there is a space $2\frac{1}{2}$ feet high, to give the syrup room for frothing up without boiling over. The space of the bottom receives steam of common pressure, and the spiral tubes, of high pressure.

The duly clarified, concentrated, granulated, and reheated syrup, is transferred, by means of copper basins, from the coolers into conical moulds, made either of brown and somewhat porous earthenware, or of sheet iron, strongly painted. The sizes of the moulds vary, from a capacity of 10 pound loaves, to that of 56 pound *bastards*—a kind of soft brown sugar obtained by the concentration of the inferior syrups. These moulds have the orifices at their tips closed with bits of twisted paper, and are set up in rows close to each other, in an airy apartment adjoining the coolers. Here they are left several hours, commonly the whole night, after being filled, till their contents become solid, and they are lifted next morning into an upper floor, kept at a temperature of about 80° by means of steam pipes, and placed each over a pot to receive the syrup drainings—the paper plug being first removed, and a steel wire, called a piercer, being thrust up to clear away any concretion from the tip. Instead of setting the lower portion of the inverted cones in pots, some refiners arrange them in wooden racks, with their apices suspended over longitudinal gutters of lead or zinc, laid with a slight slope upon the floor, and terminating in a sunk cistern. The syrup which flows off spontaneously is called green syrup. It is kept separate. In the course of two or three days, when the drainage is nearly complete, some finely clarified syrup, made from loaf sugar, called *liquor* by the refiners, is poured to the depth of about an inch upon the base of each cone, the surface having been previously rendered level and solid by an iron tool, called a bottoming trowel. The liquor, in percolating downwards, being already a saturated syrup, can dissolve none of the crystalline sugar, but only the colored molassy matter; whereby, at each successive liquoring, the loaf becomes whiter, from the base to the apex. A few moulds, taken promiscuously, are emptied from time to time, to inspect the progress of the blanching operation; and when the loaves appear to have acquired as much color, according to the language of refiners, as is wanted for the particular market, they are removed from the

moulds, turned on a lathe at the tips, if necessary, set for a short time upon their bases, to diffuse their moisture equally through them, and then transferred into a stove heated to 130° or 140° by steam pipes, where they are allowed to remain for two or three days, till they be baked thoroughly dry. They are then taken out of the stove, and put up, in blue paper for sale.

ON THE PRESERVATION OF WOOD.

A PAPER bearing this title was lately read before the French Academy of Sciences, by its author, Dr. Boucherie, and we insert it, because the subject has lately attracted considerable attention, and considering the extensive employment of wood for paving, every thing relative to the subject is important.

He contrasts the increasing consumption and the rapid decay of timber, with its slow rate of production, which make it necessary to economize its employment. He adverts to the many projects for its preservation, enumerated first by our countryman Mr. John Knowles, and the methods subsequently proposed, to many of which he objects from their uselessness; to others from the slow and superficial manner in which timbers part with their contained fluids, or absorb new ones, by simple immersion, (circumstances long since proved by Duhamel;) and to all from their expense, the ultimate test of general application.

Dr. Boucherie argues, that all the changes in woods are attributable to the soluble parts they contain, which either give rise to fermentation or decay, or serve as food for the worms that so rapidly penetrate even the hardest woods. As the results of analysis he says, that sound timbers contain from three to seven per cent. of soluble matters, and the decayed and worm-eaten rarely two, commonly less than one per cent.; he therefore concludes that "since the soluble matters of the wood were the causes of the changes it undergoes, it is necessary to its preservation, either to abstract the soluble parts in any way, or to render them insoluble by introducing substances which should render infermentable or in-alimentary;" which he considers may be done by many of the metallic salts and earthy chlorides.

Dr. Boucherie shows, by parallel experiments upon "vegetable matters very susceptible of decomposition, as flour, the pulps of carrot and beet-root, the melon, &c., (which only differ from wood, of which they possess the origin and constitution, by the greater proportion of soluble matter which they contain,)" that in the natural states they rapidly alter, but are preserved by the pyrolignite of iron, (pyrolignite *brut* de fer,) a cheaper material than the corrosive sublimate commonly used, and one very desirable in several respects. He presumed that by immersing the end of a tree immediately after it was felled into a liquid, the vital energies not having ceased, the tree would then absorb such fluid through all its pores, by a process which he calls aspiration; and in this fortunate surmise he was entirely successful. This led step by step to numerous practical results, which their inventor enumerates as follows, and describes in separate chapters.

1st. "For protecting the woods from the dry or wet rot."

2nd. "For augmenting their hardness."

3rd. "For preserving and developing their flexibility and their elasticity."

4th. "For rendering impossible the changes of form (*jeu*) they undergo, and the splits (*dijonctions*)

which take place when they are brought into use, or are submitted to atmospheric changes."

5th. "For greatly reducing their inflammability and combustibility."

6th. "For giving them various and lasting colors and odours."

We shall endeavour to convey a general notion of the methods in the same order.

1. Durability. He took a poplar tree, measuring 28 *mètres* in height, and 40 *centimètres* diameter, simply divided from its root with its branches and leaves undisturbed, and immersed it erect to the depth of 20 *centimètres* in a vessel containing pyrolignite of iron; in six days it was entirely impregnated even to the leaves, and had absorbed the large quantity of three *hectolitres*. This method required powerful lifting apparatus, and a support for the tree to lean against, and was therefore objectionable. He repeatedly operated upon trees lying on the ground, by attaching to their bases waterproof bags containing the liquid: the experiments were varied in many ways; sometimes portions of the branches were lopped off, but the crown or tuft was always left upon the principal stem; at other times the aspiration was effected by boring detached holes near the earth supplied with different fluids, which gave rise to all kinds of diversities; and other trees were pierced entirely through, and a horizontal cut extending to within an inch or so of each side was made with a thick saw, leaving only sufficient wood for the support of the trees.

For fear of losing the trees upon which he had the opportunity of experimenting, the process was not deferred beyond 24, 36, or 48 hours after they were felled, as the vigour of the absorption was found to abate rapidly after the first day, and that at about the tenth day it was scarcely perceptible: it was also found the aspiration entirely failed in dead wood, whether occurring at the heart of old trees, or at parts of others from any accidental interruption of the flow of the sap during the growth; and also that resinous trees absorbed the fluids less rapidly than others. Observations were also made of the quantities of the liquids taken up; these, when of a neutral kind, as the chloride of soda, often equalled in bulk that of the wood itself, without causing any addition to its weight; the acid and alkaline fluids were less abundantly absorbed, apparently from contracting the vessels by their astringent action. It is stated that the pyrolignite of iron effected the preservation of the substance when equal to less than a fiftieth of the weight of the green wood. These points are all separately treated in the original paper.

2. The hardness of the wood was considered by various workmen to be more than doubled by the action of the pyrolignite.

3. The flexibility (due to a certain presence of moisture) was increased in a remarkable manner by the chloride of lime and other deliquescent salts, the degree of elasticity depending upon their greater or less concentration. As a cheap substitute for the above, the stagnant water of salt marshes was adopted, with a fifth of the pyrolignite, for the greater certainty of preservation. Pieces of prepared deal, 3 *millimètres* thick, and 60 *centimètres* long, were capable of being twisted and bent in all directions, as into screws, also into three circular coils; the wood immediately regained its figure when released; this condition lasted eighteen months, that is, until the time his paper was read.

4. The warping and splitting, principally due to

the continual effect of the atmosphere in abstracting and restoring the moisture, was stayed by impregnating the wood with a weak infusion of the chloride, so as always to retain it to a certain degree moist; one-fifth of pyrolignite was also added in this case. The seasoning of the wood was also considered to be expedited by the process, and which was not found to interfere with the ordinary use of oil-paint, &c. Large boards of the prepared wood, some of which were painted on one or both sides, and similar boards of unprepared wood were compared; at the end of twelve months, the former were perfect as to form, the latter were warped and twisted as usual.

5. The inflammability and combustibility of the woods were also prevented by the earthy chlorides, which fuse on their surfaces by the application of heat, and render them difficult of ignition. Two similar cabins were built of prepared and of ordinary wood respectively, and similar fires were lighted in each; the latter was entirely burned, the other was barely blackened.

6. In respect to colors infused by the aspiratory process, the vegetable colors were found to answer less perfectly than the mineral, and the latter succeeded best when the color was introduced at two processes, so that the chemical change, (that of ordinary dyeing) occurred in the pores of the wood itself. Odorous matters, required to be infused in weak alcoholic solutions, or essential oils, they were considered to be equally durable with those supplied by the hand of nature; and resins similarly introduced were found to increase amazingly the inflammability of the woods, and to render them impervious to water.

In a word, the method promises the means of working almost any desired change in the constitution and properties of woods, when the fields are presented to them before the vitality of the tree has ceased. It is true we have as yet only two years' trial of these experiments, but they have been scientifically deduced, and their inventor is still engaged in prosecuting them. It is to be hoped, and also expected, that these interesting and flattering promises of success will be realized, and even extended, when tried by that most severe of all tests, time.

GALVANIC REDUCTION OF ZINC, IRON, AND TIN.

As we have before fully explained the manner of operating upon copper with the galvanic battery, it will now only be necessary to allude to these metals in a general manner, the process of operating upon other metals being supposed to be known.

Zinc may be reduced in the bright metallic state from a variety of solutions, as the oxyde of zinc is soluble in a great number of acids. The sulphate of zinc, however, is by far the most common salt of this metal, and it is formed tolerably pure and in large quantities during the employment of galvanic batteries. The solution of the sulphate of zinc may be of any strength, but perhaps the stronger is to be preferred. It should be as neutral as possible, and it is a good plan to add a little oxyde of zinc to the sulphate, but this salt always reddens litmus paper. Zinc can only be reduced practically by the battery process. In the trough it is as well to use a very large zinc positive pole, and take especial care to cause a proper diffusion of the new sulphate of zinc. Hydrogen has a considerable tendency to be evolved from the solution. The battery should be

small as the galvanic power should be feeble, and the resistance in this case should be rather in the battery or the connexions than in the positive pole. Reduced zinc may be thrown down in a very flexible state, and is far more slowly acted upon in dilute sulphuric acid than common zinc.

The chloride of zinc is usually formed by dissolving the metal in muriatic acid, when hydrogen is most abundantly evolved. It is now occasionally used in surgery as an escharotic, and it may be employed for electro-metallurgy in the same way as the sulphate of zinc. It is a good solution, but possesses no particular advantages. If chloride of zinc is formed by the galvanic battery, it is better adapted for electro-metallurgy. The oxyde of zinc is very soluble in muriate of ammonia. There is a great tendency to the evolution of hydrogen in this solution, and therefore it is not a good compound for the reduction of the reguline metal, though it is well adapted for obtaining zinc sponge in large quantities. The acetate of zinc may be formed by digesting oxyde of zinc in pyroligneous acid, or by making zinc the positive pole in that fluid. It is a very good solution for obtaining reguline metal by the single battery process.

The reduction of the zinc is not of much importance in itself, although very interesting when considered in reference to the plates of galvanic batteries; for if one battery in a compound series, from any cause, has the whole of its exciting fluid neutralized, then will that cell be in the same condition as the apparatus employed for the reduction of the zinc, and zinc will immediately be deposited on its negative pole. This will occur with all the forms of batteries now employed, although it is a property of no consequence, as the action of the battery ought to be stopped before it has so thoroughly exhausted itself. When this deposit takes place, it can readily be removed by placing the plate in contact with any metal which can act as a negative plate to it. The necessity of this arises from the difficulty with which pure zinc is dissolved in acid. As soon as a dozen or more batteries, arranged as a series, have the acid of their exciting fluid saturated with zinc, the zinc will be deposited on the negative plate, if a single battery only out of the whole number contain any acid; thus eleven batteries out of twelve may have their negative metal thickly coated with a very beautiful and perfect deposit of zinc, whilst the last will not have the smallest trace upon it. Zinc is never found in all batteries of a series.

In the reduction of zinc from any salt there is a difficulty to be encountered for reguline zinc of the best quality may go down at first, but afterwards one of the varieties of the spongy deposits will take place. This alone forms a great impediment to the reduction of zinc on a large scale. The reduction of zinc is generally a disadvantageous process, as the cost of its deposition is the same as that of copper, from their voltaic equivalents being alike. Zinc, however, is worth but threepence a pound, whilst the value of copper is a shilling.

The salts of iron have a strong tendency to be peroxydised, in which state they cannot be reduced by the voltaic current. We must use, therefore, the proto-salts of which the proto-sulphate of iron is a good example; this is prepared very carefully for the use of chemists, and the reduction of metallic iron may take place from a solution of their proto-sulphate. The metal upon which the deposit is to be effected is connected with the zinc of the battery, whilst an iron nail is connected with the silver; as

source of power, a relatively small single battery will suffice, and the silver need not be larger than the negative pole in the trough. The nail is to be just so far dipped into the solution, that the minutest quantity of hydrogen, or none at all, is evolved from the metal to receive the iron; and after the lapse of a short time, the negative metal will become coated with metallic iron. The reduced metal is brighter, and rather whiter than polished steel, but it soon tarnishes in the air.

Proto-chloride of iron may be formed by dissolving iron in muriatic acid; it forms a perfectly neutral salt, and is well adapted for the reduction of the metal. It may be reduced by either battery process, of which the single battery will always suffice. The hydrogen has not so great a tendency to be evolved as in the sulphate, and the metal goes down freely from it. This is an excellent solution, perhaps the best for the reduction of this metal. If the iron is removed from the plate on which it is deposited, the surface next to the negative pole is polished if the original is so also; and very thin layers of this metal have a very fair cohesion, inferior, however, to the rolled iron of commerce. Iron may be reduced, but only in the minutest quantity, from the ferro-cyanate of potash, which is, therefore, useless for electro-metallurgy.

Iron reduced by electricity has not yet been examined as to its magnetic properties, and, doubtless, pure iron obtained in this manner must possess peculiar properties still undiscovered. The reduction of iron in a pecuniary point of view is the very worst process in the whole range of electro-metallurgy; for the metal is worth scarcely anything in comparison with others we have to treat of. The iron-masters, doubtless, will sleep in perfect security when they are told, that for one equivalent of galvanic power derived from a battery costing $\frac{1}{10}$ of a penny, but 28 grains of iron are reduced; so that the reduction of 1 lb. of iron, worth about one penny, would cost more than one shilling for the bare materials used in its reduction, to be added to the value of the metal.

Tin is a difficult metal to manage, because the transition from the decidedly spongy state to the crystalline is so rapid, that we can scarcely hope to obtain any amount of reguline metal. The salts have the same general characters. The muriate is the most common of the salts of tin. It yields very fine crystals when decomposed by a small battery, with a tin positive pole. If the battery is very active, the tin positive pole large, and the solution strong, the growth is marvellous; a little point will present itself on the negative metal, which rapidly increases, and in a few seconds will grow to the positive pole. If during this rapid growth the positive pole be moved the crystal will follow it.

The finest crystals are obtained, however, by the strongest neutral metallic solution, and a very low action in the battery. The deposit is certainly very beautiful. The spongy deposit of tin is very peculiar, and the electro-metallurgist is apt to see it much oftener than he wishes; for that light, flocculent, spongy deposit, which is frequently observed during the action of the battery, is nothing but metallic tin, arising from zinc clippings mixed with solder being melted with the rough spelter; if a little of this mass be squeezed between the fingers into a mass, and then struck and rubbed against anything hard, a bright metallic surface will be exposed.

The sulphate of tin may be formed by digesting the proto-oxide in dilute sulphuric acid; it is rather a better salt than the other; and might be used for some purposes to coat iron. A kind of lesser crystalline deposit may be obtained from it, but not sufficiently good to form a tin medal.

The oxalate of tin and acetate of tin are made in the same way as the sulphate. They are not quite such good conductors as the sulphate, and do not yield good reguline tin to any extent.

THE BRITISH MOSSES.

(Resumed from page 348, and concluded.)

Germination.—The germination of the seeds has been remarked by numerous botanists; first by the ind-fatigable Hedwig, who observed the young plants to issue from the ground furnished with succulent, round, jointed filaments, which appearing to take their origin in the seed itself, he designated seed lobes or cotyledons. Sprengel also observed these bodies, and considered them rather unphilosophically *confervæ*, and consequently distinct and independent of the moss itself, though why a moss should not grow without a *conferva* attached to it, or how the seeds of the two became first united, he has neglected to inform us. The most accurate observations upon this subject are those of Mr. James Drummond, F.L.S., and published by him in the "Linnæan Transactions." His remarks are so full of instruction, that it is impossible to refrain from quoting some of them. He says:—"In *Funaria hygrometrica*, these processes, (alluding to the *confervoid* filaments,) made their appearance on the second day after sowing, in the form of pellucid points, evidently growing out of the substance of the seed. On the fourth day, each minute plant had from one to three of these appendages, each appendage growing out of a different part of the brown covering of the seed, which sometimes appeared torn, as described by Hedwig, from the bursting out of these filaments. On the seventh day, they appeared, when magnified with the highest power of a compound microscope, to be about two lines in length, obtuse, jointed; and when growing in water, having some green colored particles appearing within them, similar to what we find deposited in the cells of the leaves, in a more advanced state of the plant. But I observed that some of the articulated filaments, in the pots of earth, penetrated the soil in every direction, and formed the roots, those filaments only being of a green color which were growing on the surface. On the tenth day, I found these filaments beginning to throw out branches. In a fortnight, the surface of the pots appeared as if covered with green velvet, from the numerous branched filaments that clothed every part of the soil. About the end of the third week, the true leaves of the moss began to make their appearance, shooting up amongst the green articulated filaments, and attached to them in the same way as we see the serrated leaves and capsules produced in *Phascum serratum*.

"That the reticulated filaments, supposed by Hedwig to be the cotyledons of mosses, are essentially different from the seed leaves of phænogamous plants, will appear from the following experiment. I removed a portion of the surface from the pots in which I had mosses growing from seeds, and I found, (provided I did not go deeper than the *confervoid* substance had penetrated,) that the green part of the *conferva*, and ultimately the moss itself, was reproduced; and I have since found that the small

creeping roots of *Polytrichum commune*, and other mosses, when the soil in which they grow is exposed to the air, throw out green articulated filaments, and produce young plants in a much shorter time than what it takes to produce them from seed. I find the time which mosses remain in the *confervoid* state, before they produce their true leaves, to vary considerably in different species, and even in the same species under different circumstances. When regularly supplied with moisture, *Funaria hygrometrica*, *Gymnostomum pyriforme*, *Didymodon prorepens*, *Bryum hornum*, and some others, produce their true leaves in about three weeks from the time of sowing; *Polytrichum undulatum* requires two months; and *Polytrichum aloides* sometimes continues four months in a *confervoid* state. The last mentioned in that state is the well-known *Bryum velutina*.

"The duration of the green part of the *confervoid* filaments on the surface, after the mosses produce their true leaves, depends much on the soil and situation in which they grow. In *Phascum serratum*, and *Polytrichum aloides*, they are almost always present, and in some mosses, supposed to be annual, I have found them remain, and throw up plants in succession for several years."

Such is the general structure of the mosses—the anomalies to be met with are very few, yet these are in some instances widely different from the above description. All that it is here necessary to notice is, that the capsule of *Andropogon*, instead of throwing off a lid, opens by four longitudinal valves. Some of the *Phascums* are without a columella, except in their young state. Most of them part with their seed only by the decay of the capsule, while the fruit of a few fall off, and suffer the seed to escape through a hole, where previously the fruit-stalk was attached. Also, a certain degree of pubescence is apparent in one or two species of foreign nativity.

Duration, Habit, and Locality.—The duration of life of the moss tribe varies like that of flowering plants. Many of the smaller kinds are annual; reckoning their life, however, in most cases to include one winter, and which assimilates them to the biennials of phænogamous vegetation. Other, and particularly the larger species, are perennial, but of what duration their life is, we have in vain sought for information. It is certainly of long continuance, as we may year by year witness upon a wall the same tufts of *Grimmia pulvinata*; and on a trunk of some well-known tree the same tufts of *Hypnum sericeum*. They are among the most minute of all vegetables—the larger of them scarcely exceeding a few inches in height—the majority not an inch, while some are so minute as hardly to be visible to the naked eye, unless accumulated in multitudes. There is no country, perhaps, entirely exempt from some or other of the moss tribe, and in many places they, with the lichens, form the chief vegetation. Melville Island, the north coast of Siberia, Greenland, Terra del Fuego, Patagonia, and other intensely bleak and desolate regions, in which the ice and snow scarcely ever melt more than a few inches in depth, green mosses form almost the only turf. In the temperate countries, particularly such as are mountainous and filled with swampy woods, mosses still more abound. Norway, Sweden, the Alpine parts of Scotland, the heights of the Alps, the Carpathians, the Apennines, and the Pyrenees, afford a rich harvest to the diligent muscologist. The tropical regions being drier and hotter have not that number of species and those multitudes of

individuals which colder and damper places furnish in such abundance, yet not even in this most unfavorable situation are mosses wholly absent. Sir W. J. Hooker has received stems of cocoa-nut trees from the torrid zone, entirely covered with moss, and other kinds gathered on the burning sands of the deserts in the interior of Africa. The British islands are rich in the mosses, producing more than 300 species, and these so scattered and abundant that it is impossible to overlook them.

Let it not, however, be supposed that season and soil are indifferent to them; on the contrary, they appear subject to peculiar laws no less than other plants. Being nourished by moisture, they are most luxuriant in those seasons when moisture abounds—those species, natural to dry situations, for the most part vegetate in the autumn—grow to their full size during the winter—and fruit in the early spring—then dying, or else shrivelling up during the heat of summer, to be resuscitated again by the return of the wet and dewy atmospheres of the succeeding autumn.

Uses and Properties.—Mosses are not supposed to tend much to supply the immediate wants of mankind—their medicinal properties are scarcely beyond a slight astringency. No species is used as food either by men and animals—none yield either perfumes, dyes, or textile materials. The employment of them is therefore very limited, and confined chiefly to the gardener and angler. The latter finds nothing so good as damp moss wherein to keep his worms first, and the fish afterwards. Many kinds of the latter may be kept alive a considerable time, if covered with wet moss. So the gardener packs up his bulbous roots, seeds, and other similar objects in dry moss; and being well aware of the quantity of water that such a substance absorbs, he applies this knowledge usefully, by suffering moss to grow around the blocks of wood, and within the baskets where his orchideous and similar plants are suspended in the conservatory, and surrounding with it the roots of fresh plants that are to be conveyed to a distance. The mosses of the trees, brakes, and damp hedge-rows, afford indeed to the entomologist the scene of one of his richest harvests, and it may be said to insect-eating birds, the source of a constant supply of food. Nor are the feathered race and the smaller quadrupeds, the dormouse and the squirrel, negligent of the soft and silky kinds in forming their nests and winter habitations.

All these uses are exceedingly trivial when compared with the important value of this tribe in the great economy of nature. It is to it, in conjunction with the lichen, that we must look for the first step towards fertility. A hard and sterile cliff, the scoria of a volcano, the sandy desert, even a new wall in the midst of a city, will often, when a damp atmosphere envelops it, become clothed with minute mosses. The death and decay of these yield a little earth—another race springs up, adding its mite to the general heap, till at length a fern or a grass finds sufficient soil to maintain it; after which vegetation progresses rapidly, until at length we find sterility changed to fruitfulness—a barren desert to a smiling meadow. Such is the generally-recorded opinion, and such remarks have been echoed from age to age; yet we doubt their full force—examine any wall, and see how rarely a fern or a grass is imbedded in a tuft of moss, or else look on the trunk of a tree, where we may know that moss has grown for

years, and we shall find no trace of any other plant; whilst, on the contrary, the walls and rocks require but the wind to waft a little dust into their interstices, or the combined action of rain and frost to pulverise a small portion of their softer parts, when although mosses may sometimes spring up, yet we constantly witness other plants appearing without the intervention of the tribe we are now considering.

The most important use of the mosses has been apparently overlooked. We allude to the formation of peat, and the filling up and consolidating the fens and morasses, of which we have such notable instances in our own country. These places were all probably once lakes: more or less shallow. The deeper parts of these give life to various of the Algae and Characeae, while upon the shallower parts grow the Sphagnum or bog mosses—in process of time these choke the Charas and usurp the whole surface, and as they grow very rapidly, in dense masses, which die annually, the lakes become bogs—the surface is consolidated, and herbage succeeds, while the substratum becomes compressed, and peat, more or less compact, is formed. We know not how much this cause and this agency may have conducted to the formation of those immense deposits of coal which exist everywhere in the north, and with what confidence political economist may look to the bogs of the Sister Isle for a supply of that useful material, 2000 years hence, would be irrelevant to inquire. At any rate the constant formation of a substance very analogous to coal is subject to our every-day observation, and that from the despised, the fragile, and the apparently-worthless moss.

COLORS FOR VELVET PAINTING.

(To the Editor.)

SIR,—If you think the following receipts of colors for velvet painting of any use, they are at your service:—

Golden Yellow.—1 oz. bruised turmeric macerated in 4 oz. spirits of wine.

Yellow.—Boil $\frac{1}{2}$ lb. French berries powdered, $\frac{1}{2}$ oz. alum, and $\frac{1}{2}$ oz. gum dragon in a pint of water to one half.

Blue.—Dissolve a cake of Prussian blue and $\frac{1}{2}$ oz. gum dragon in a teacup full of water.

Green.—Dissolve a cake of Prussian blue in a teacup full of yellow, and stiffen with gum dragon.

Brown.—Burnt umber ground smooth.

Carmine.—1 dram carmine, and 4 table-spoonful of boiling water, add $\frac{1}{2}$ oz. spirits of hartshorn, boil 2 minutes, let it stand and strain it through muslin.

Orange.— $\frac{1}{2}$ dram hay saffron in tea cup of boiling water and a little gum.

Purple.— $\frac{1}{2}$ lb. logwood, $\frac{1}{2}$ oz. alum, $\frac{1}{2}$ oz. of gum dragon, and 1 pint of water boiled to one half.

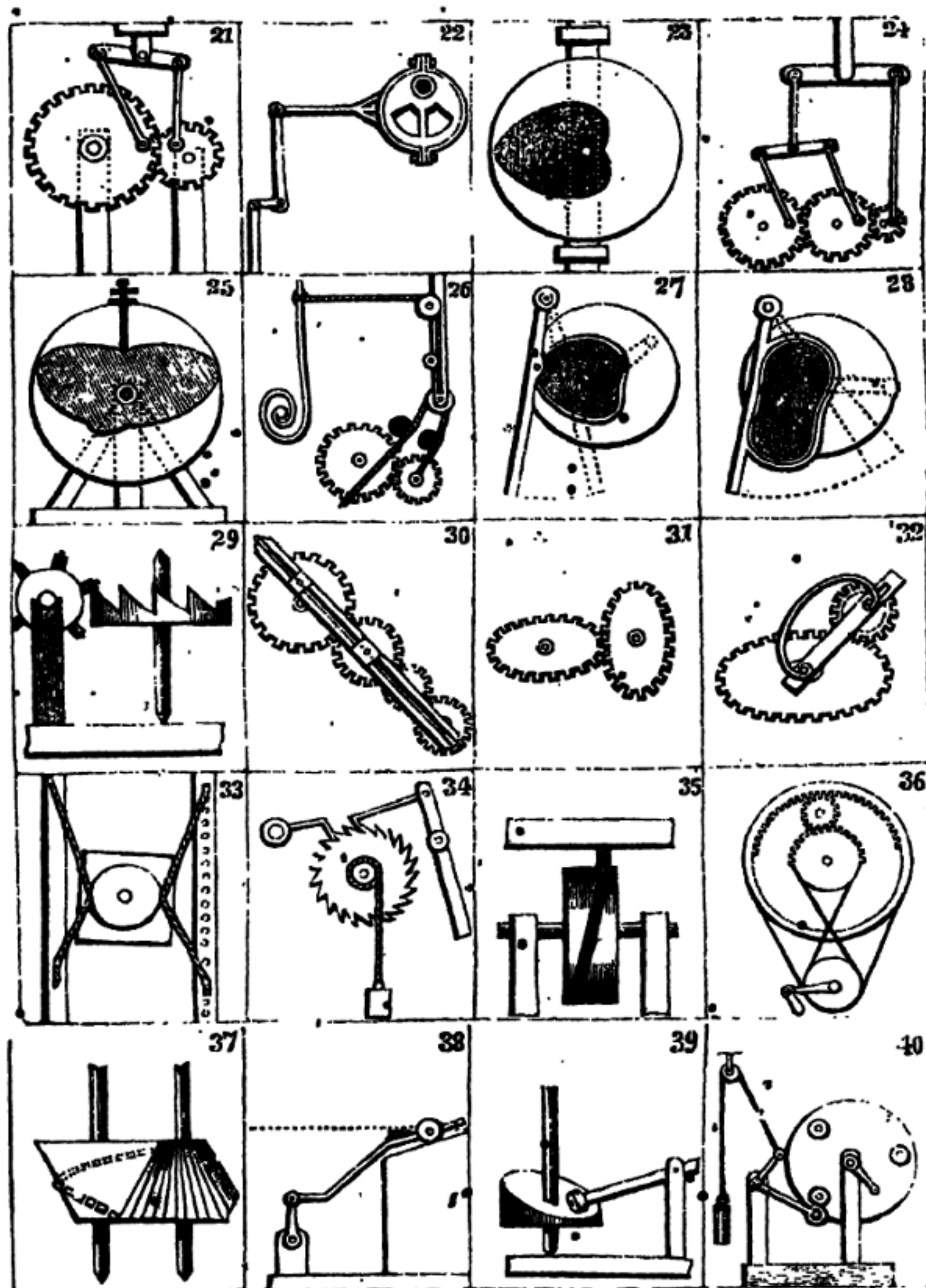
SCIENTIFICUS.

P. S.—The following crimson stain for paper may also be serviceable:—Take of powdered cochineal 1 dram, alum 1 oz., cream of tartar 1 oz., water 1 pint, boil and strain. Apply it to the paper with a brush.

QUERIES.

14. What is the liquid with which small glass globes are filled, used for magnifying?—Water

15. What is the cause of the twinkling of the stars?



MECHANICAL CONTRIVANCES.

MECHANICAL CONTRIVANCES.

(Resumed from page 347.)

FIG. 21, shows a method of producing a traversing rectilinear motion, by means of a continued circular one. It is evident, that if either one wheel or the other of this apparatus be put in continued motion around its axis, the perpendicular beam at top must rise and fall, it being joined by cross bars, and moveable connecting pieces, with these wheels. If this figure be reversed and the wheels be equal, it forms the contrivance used by Cartwright, instead of the parallel motion, for his steam engine. If the wheels are unequal in size, as in the cut, the parallelism will not be destroyed, but the quantity of the motion or the amount of traverse will be affected.

FIG. 22, is the eccentric motion of the steam engine. Suppose the crank shaft of a steam engine have a large circular disc fastened upon it, in such a way that the centre of the shaft shall not coincide with the centre of the disc, as is shown by the small black circle depicted within the larger circle on the right-hand side of the figure, it would, if the spindle were made to turn round, the disc moving with it, wobble, or not turn smoothly, as the turner always witnesses when his work is not fastened centrally with the mandril and back poppet. Supposing a moveable collar attached to a long beam, and connected with a series of levers, were placed over the circular disc, it is evident that the lever attached to the collar would be drawn backwards and forwards at every revolution of the spindle, and consequently move the whole series of levers. This apparatus is used to work the valves of steam engines.

FIG. 23. This is a modification of the last, and will form a uniform traverse of the upright beam, and to which a circular plate is attached. As the heart-shaped cam revolves, it will move the hollow circular wheel or hoop up and down. In automata this is the method usually employed to occasion a rider on horseback to rise and fall in the saddle, as well as for many purposes in more important machinery.

FIGS. 24 and 26. These are modifications of fig. 22. In both cases are shown the methods of producing a parallelism of perpendicular motion, when the part to be moved is not exactly over the wheels which are to give it motion. In the first method, (24,) it is by rigid bars, and consequently all the apparatus is supposed in the same plane. In the method, fig. 26, it is accomplished by means of bands or strings, therefore by a little contrivance, the first cause of motion may be at one part of the machine, and the beam moved at another; the band is kept to its work by means of a spring.

FIG. 25. This figure shows a cam of a peculiar shape, as an illustration of a variable perpendicular motion, which may be given to the small upright rod which lodges on the cam; as this latter is turned round, it raises the bar in the same irregular manner as the cam itself. It is supposed that the small bar has a spring at the farther end to keep it steadily to the surface. Now suppose this machine be placed horizontally, and that a pencil point be attached to the rod, a paper being placed underneath, the pencil would in each revolution of the cam, move along three times away from the centre, and three times towards it. Yet, notwithstanding this motion of the pencil, there would be but one line. Now let us suppose that we have a second cam sideways with the former, and which shall carry the rod sideways,

while the former carries it up and down; the consequence would be that the pencil would obey both motions, and a very irregular diagonal line be produced. By apportioning the working of two such cams as this, but of the peculiarly required shape, by making them both act at once, or alternately, throwing one out of gear while the other is in action, and other contrivances of a like nature, are formed the ships, houses, and other objects drawn by an automaton, which is often shown at exhibitions.

FIGS. 27 and 28. These are both traverse motions produced by circular motions, precisely in the same manner as in the last case, and will be easily understood.

FIG. 29, represents a plan and elevation of a wheel constructed with a succession of inclined planes or teeth, on which the small rollers on the periphery of the smaller wheel act, and thereby transfers circular motion in a right-angled direction.

FIG. 30. Let the train of wheels be in the proportion of 2, 1, 2, 4, and the sliding part over the second 2, and the 4 fixed at any eccentric points on the respective wheels; the revolution of the wheels will cause the bar to describe curved lines, which may be varied according to the position of the points to which the bar is attached.

FIG. 31. This is a method of producing a varying, but a regular motion from an equable one.

FIG. 32. This is very similar to the last, for supposing a uniform velocity to be imparted to the small pinion, which is allowed to traverse in the slot cut in the fixed bar which supports it, the oval wheel will be revolved at a variable velocity, according to the several parts of its periphery, which come into gear with the pinion.

FIG. 33. This arrangement is used for polishing mirrors, where it is essential that the friction should not be repeated in the same line. The ropes which go round the central pulley are fast to the two perpendicular shafts, and the square mirror is fixed to the pulley. Thus by the back and forward motion of one of the shafts, the mirror is caused to describe irregular curves on every part of its surface.

FIG. 34. This is a means of gathering up a rope by means of a vibrating lever, connected with a catch, which gathers a tooth of the ratchet wheel at every vibration, thereby revolving the shaft on which the rope is coiled. The lever may be worked by means of the hand in the same manner as a pump handle.

FIG. 35. This figure shows how a slight vibrating horizontal motion may be given to a shaft, by means of a vibrating wheel in which an oblique slot is cut. The extent of motion of the beam at top will be in proportion to the obliquity of the slot.

FIG. 36. Suppose the small pulley or wheel at the bottom to be the driver; the larger wheel with an internal rack, and the concentric wheel within will be driven in opposite directions by the bands as represented, and at the same time impart motion to the intermediate pinion near the top, both round its own axis, and also round the common centre of the circular rack and concentric wheel.

FIG. 37. This is a contrivance for producing a gradually decreasing motion in one wheel by an equable motion in another. Suppose the conical wheel, which is furnished with teeth all round its edge, be turned with an equable motion on its axis, and at the same time made to adjoin to a conical spindle furnished with cogs, equal in number to the teeth of the former, but arranged in a spiral form from one end to the other of it, the teeth of the

equable wheel catching into the cogs of the other, and they being at gradually decreasing distances from the centre upwards, the second wheel will move with corresponding decreased speed, until the first tooth of the first wheel, catching again the former and more centrally distant cogs of the second, will start it again with the same speed as at first.

Fig. 38. This is an arrangement for the brush movement of a machine for dressing warps, in which the revolution of the crank to the left, combined with the inclined plane on which the small roller to the right is supported, produces the brushing motion on the warp, which is represented at the dotted horizontal line.

Fig. 39, shows the action of a curved line in vibrating the lever which rests on its face.

Fig. 40, shows a very good pounding motion. Suppose the wheel to be turned round by a handle or otherwise, and to have three small wheels or pulleys attached near to its circumference, and on one side of it. Next suppose the bent lever to be attached to the post, and to a rope and pulley as represented, the other end of the rope bearing a weight. As the wheel turns round, the friction wheel at the end of the lever will be forced downwards, and the other end proportionably raised, or when it has passed the small pulley upon the wheel, it will, of course, fall by its own weight, and thus rise and fall three times in each revolution of the wheel.

(To be continued.)

CANNEL COAL AS A WORKING MATERIAL.

CANNEL coal is principally obtained in England from Yorkshire, Shropshire, Derbyshire, and Cumberland; it is also found in parts of Scotland and North Wales. It occurs in seams, generally about three inches, but occasionally one foot thick, amongst ordinary coal; sometimes, as at the Angel Bank Colliery, near Ludlow, it constitutes the entire bed. Compared with jet it is much more brittle, also heavier, and harder; it is less brown when worked, less brilliant, but more durable when polished; neither of them are at all influenced by acids or moisture, although they temporarily expand by heat.

Cannel coal may be thought to be a dirty and brittle material, but this is only partially true; it is far better suited to the lathe than might be expected, although a peculiar treatment is called for in the entire management, which commences with the selection of pieces free from flaws, of a compact grain, and of a clean conchoidal rather than of a flaky structure.

As regards the artificer, cannel coal may be considered to be made up of horizontal layers, and to have a grain something like that of wood. The horizontal surface may be readily distinguished from the vertical, either by its splitting off in flakes, or by its appearing as if varnished at those parts contiguous to the ordinary coal, and which must be chipped away as useless; sometimes hard fragments or crystals, apparently of iron ores, interrupt its uniformity of surface, and flaws, which show when broken the varnished appearance, occasionally diminish its strength.

The material is cut out with a saw; that for ivory is most proper, but the hand-saw will answer; the pieces are then roughed to the shape with a chopper, or a parallel blade of steel, about eight inches long, one and a half wide, and one quarter thick,

sharpened very keenly with two ^hbevils at the one end, and used with the hand alone. For making a snuff-box, whether plain, screwed, or eccentric turned, the plankway, or the surface parallel with the seam, is most suitable; it is also proper for vases, the caps and bases of columns, &c. Cylindrical pieces, as for the shafts of columns, should be cut from either edge of the slab, as the laminæ then run lengthways, and the objects are much stronger; these latter pieces when prepared should be driven into conical chucks with a mallet, as the blow of a hammer near the edge would shiver off a flake lengthways. Similar plankway pieces, however, should be chucked with a hammer, that the blow may be exactly central, otherwise the cylindrical piece would perhaps be broken in two transversely. Cement is also very much used for chucking the work.

All the tools for cannel coal are ground with two bevils exactly like the chisel for soft wood turning, but they are held horizontally; a small gouge, from one quarter to three-eighths of an inch wide, also slightly bevilled off from within, is used for roughing out, or rather bringing the work as near as possible to the shape to save the finishing tools: these should be ground with thin and very sharp edges, otherwise they burnish instead of scrape the work. The ordinary tools for ivory and hardwood, if employed, must be held downwards at an angle of about twenty degrees; these are sometimes used with a wire edge turned up in the manner of a joiner's scraper.

The plankway surfaces turn the most freely, and with shavings much like those of wood, the edges yield small chips, and at last a fine dust, but which does not stick to the hands in the manner of common coal. Flat objects, such as inkstands, are worked with the ordinary joiners' planes, &c.; but with these likewise, it is also better the edge should be slightly bevilled on the flat side of the iron. The edges of cannel coal are harder, and polish better than the flat surfaces.

[From *Holtzapffel's Turning*, an excellent work, which we shall have occasion to examine more closely next week.—ED.]

FUEL.

DOCTOR BLACK divides fuels into five classes. The first comprehends the fluid inflammable bodies; the second, peat or turf; the third, charcoal of wood; the fourth, pit-coal charred; and the fifth, wood, or pit-coal, in a crude state, and capable of yielding a copious and bright flame. The fluid inflammables are considered as distinct from the solid, on this account, that they are capable of burning upon a wick, and become in this way the most manageable sources of heat; though, on account of their price, they are never employed for producing it in great quantities, and are only used when a gentle degree, or a small quantity of heat, is sufficient. The species which belong to this class are alcohol and different oils. The first of these, alcohol, when pure and free of water, is as convenient and manageable a fuel for producing moderate or gentle heats as can be desired. Its flame is perfectly clean, and free from any kind of soot; it can easily be made to burn slower or faster, and to produce less or more heat, by changing the size or number of the wicks upon which it burns; for, as long as these are fed with spirit, in a proper manner, they continue to yield flame of precisely the same strength. The cotton,

or other materials, of which the wick is composed, is not scorched or consumed in the least, because the spirit with which it is constantly soaked is incapable of becoming hotter than 174° Fahrenheit, which is considerably below the heat of boiling water. It is only the vapor that arises from it which is hotter, and this, too, only in its outer parts, that are most remote from the wick, and where only the combustion is going on, in consequence of communication and contact with the air. At the same time, as the alcohol is totally volatile, it does not leave any fixed matter, which, by being accumulated on the wick, might render it foul, and fill up its pores. The wick, therefore, continues to imbibe the spirit as freely, after some time, as it did at the first. These are the qualities of alcohol as a fuel. But these qualities belong only to a spirit that is very pure. If it be weak, and contain water, the water does not evaporate so fast from the wick as the more spirituous part; and the wick becomes, after some time, so much soaked with water, that it does not imbibe the spirit property. The flame becomes much weaker, or is altogether extinguished. When alcohol is used as a fuel, therefore, it ought to be made as strong, or free from water, as possible.

Oil, although fluid like spirit of wine, and capable of burning in a similar manner, is not so convenient in many respects. It is disposed to emit soot; and this, applying itself to the bottom of the vessel exposed to it, and increasing in thickness, forms, by degrees, a soft and spongy medium, through which heat is not so freely and quickly transmitted. It is true we can prevent this entirely by using very small wicks, and increasing the number, if necessary, to produce the heat required. Or we may employ one of those lamps, in which a stream of air is allowed to rise through the middle of the flame, or to pass over its surface with such velocity as to produce a more complete inflammation than ordinary. But we shall be as much embarrassed in another way; for the oils commonly used, being capable of assuming a heat greatly above that of boiling water, scorch and burn the wick, and change its texture, so that it does not imbibe the oil so fast as before. Some have attempted a remedy, by making the wick of incombustible materials, as asbestos or wire; but still, as the oil does not totally evaporate, but leaves a small quantity of gross, fixed, carbonaceous matter, this, constantly accumulating, clogs the wick to such a degree, that the oil cannot ascend, the flames become weaker, and in some cases, are entirely extinguished. There is, however, a difference among the different oils in this respect, some being more totally volatile than others. But the best are troublesome in this way, and the only remedy is, to change the wicks often, though we can hardly do this and be sure of keeping always an equal flame.

The second kind of fuel mentioned, peat, is so spongy, that, compared with the more solid fuels, it is unfit to be employed for producing very strong heats. It is too bulky for this; we cannot put into a furnace, at a time, a quantity that corresponds with the quick consumption that must necessarily go on when the heat is violent. There is, no doubt, a great difference in this respect among different kinds of this fuel; but this is the general character of it. However, when the desire to produce and keep up, by means of cheap fuel, an extremely mild, gentle heat, we can hardly use any thing better than peat. But it is best to have it previously charred, that is, scorched, or burnt to black coal. The advantages gained by charring are considerable. When it is

prepared for use in that manner, it is capable of being made to burn more slowly and gently, or will bear, without being extinguished altogether, a greater diminution of the quantity of air with which it is supplied, than any other of the solid fuels.

The next fuel in order is the charcoal of wood. This is prepared by piling up billets of wood into pyramidal heap, with several spiracles, or flues, formed through the pile. Chips and brushwood are put into those below, and the whole is so constructed as to kindle throughout in a very short time. It would burst out into a blaze, and be quickly consumed to ashes, were it not covered all over with earth or clay, beaten close, leaving openings at all the spiracles. These are carefully watched; and whenever the white, watery smoke is observed to be succeeded by thin, blue, and transparent smoke, the hole is immediately stopped; this being the indication of all the watery vapor being gone, and the burning of the true coaly matter commencing. Thus is a pretty strong red heat raised through the whole mass, and all the volatile matters are dissipated by it, and nothing now remains but the charcoal. The holes being all stopped in succession, as this change of the smoke is observed, the fire goes out for want of air. The pile is now allowed to cool. This requires many days; for, charcoal being a very bad conductor of heat, the pile long remains red hot in the centre, and, if opened in this state, would instantly burn with fury. Small quantities may be procured at any time, by burning wood in close vessels. Little pieces may be very finely prepared, at any time, by plunging the wood into lead melted and red hot. This kind of fuel is very much used by chemists, and as many good properties. It kindles quickly, emits few watery or other vapors while burning, and when consumed, leaves few ashes, and those very light. They are, therefore, easily blown away, so that the fire continues open, or pervious to the current of air which must pass through it to keep it burning. This sort of fuel, too, is capable of producing as intense a heat as can be obtained by any; but in violent heats it is quickly consumed, and needs to be frequently supplied.

Fossil coals charred, called cinders, or coke, have, in many respects, the same properties as charcoal of wood; as kindling more readily in furnaces than when they are not charred, and not emitting watery, or other gross smoke, while they burn. This sort of charcoal is even greatly superior to the other in some properties. It is a much stronger fuel, or contains the combustible matter in greater quantity, or in a more condensed state. It is, therefore, consumed much more slowly on all occasions, and particularly when employed for producing intense melting heats. The only inconveniences that attend it are, that, as it consumes, it leaves much more ashes than the other, and these much heavier too, which are, therefore, liable to collect in such quantity as to obstruct the free passage of air through the fire; and further, that when the heat is very intense, these ashes are disposed to melt or vitrify into a tenacious, drossy substance, which clogs the grate, the sides of the furnace, and the vessels. This last inconvenience is only troublesome, however, when the heat required is very intense. In ordinary heat, the ashes do not melt, and though they are more copious and heavy than those of charcoal of wood, they seldom choke up the fire considerably, unless the bars of the grate be too close together. This fuel, therefore, is preferable, in

most cases, to the charcoal of wood, on account of its burning much longer, or giving much more heat before it is consumed. The heat produced by equal quantities, by weight, of pit-coal, wood-charcoal, and wood itself, is nearly in the proportion of 5, 4, and 3. The reason why both these kinds of charcoal are preferred, on most occasions in experimental chemistry, to the crude wood, or fossil coal, from which they are produced, is, that the crude fuels are deprived, by charring, of a considerable quantity of water, and some other volatile principles, which are evaporated during the process of charring, in the form of sooty smoke or flame. These volatile parts, while they remain in the fuel, make it unfit (or less fit) for many purposes in chemistry. For, besides obstructing the vents with sooty matter, they require much heat to evaporate them; and therefore the heat of the furnace, in which they are burnt, is much diminished and wasted, by every addition of fresh fuel, until the fresh fuel is completely inflamed, and restores the heat to its former strength. But these great, and sudden variations of the heat of a furnace are quite inconvenient in most chemical processes. In the great number of chemical operations, therefore, it is much more convenient to use charred fuel, than the same fuel in its natural state.

It is proper to be on our guard against the dangerous nature of the burnt air which arises from charcoal of all kinds. Charcoal burns without visible smoke. The air arising from it appears to the eye as pure and as clear as common air. Hence it is much used by those persons who are studious of neatness and cleanliness in their apartments. But this very circumstance should make us more watchful against its effects, which may prove dangerous, in the highest degree, before we are aware of it. The air arising from common crude fuel is, no doubt, as bad, but the smoke renders it disagreeable before it becomes dangerous. The first sensation is a slight sense of weakness: the limbs seem to require a little attention to prevent falling. A slight giddiness succeeds, accompanied by a feeling of a flush or glow in the face and neck. Soon after the person becomes drowsy, would sit down, but commonly falls on the floor, insensible of all about him, and breathes strong, snoring as in an apoplexy. If the person is alarmed in time, and escapes into the open air, he is commonly seized with a violent headache, which gradually abates. But when the effect is completed, as above described, death very soon ensues, unless relief be obtained. There is usually a foaming at the mouth, a great flush or suffusion over the face and neck, and every indication of an oppression of the brain, by this accumulation of blood. The most successful treatment is, to take off a quantity of blood immediately, and throw cold water on the head repeatedly. A strong stimulus, such as hartshorn, applied to the soles of the feet, has also a very good effect.

The fifth and last kind of fuel is wood, or fossil coals, in their crude state, which it is proper to distinguish from charcoals of the same substances. The difference consists in their giving a copious and bright flame, when plenty of air is admitted to them, in consequence of which, they must be considered as fuels very different from charcoal, and adapted to different purposes. Flaming fuel cannot be managed like the charcoals. If little air be admitted, it gives no flame, but sooty vapor, and a diminution of heat. And if much be admitted,

to make those vapors break out into flame, the heat is too violent. These flaming fuels, however, have their particular uses, for which the others are far less proper. For flame, when produced in great quantity, and made to burn violently, by mixing it with a proper quantity of fresh air, by driving it on the subject, and throwing it into whirls and eddies, which mix the air with every part of the hot vapor, gives a most intense heat. This proceeds from the vaporous nature of flame, and the perfect miscibility of it with the air. As the immediate contact and action of the air are necessary to the burning of every combustible body, so the air, when properly applied, acts with far greater advantage on flame than on the solid and fixed inflammable bodies; for when air is applied to these last, it can only act on their surface, or the particles of them that are outermost; whereas, flame being a vapor or elastic fluid, the air, by proper contrivances, can be intimately mixed with it, and made to act on every part of it, external and internal, at the same time. The great power of flame, which is the consequence of this, does not appear when we try small quantities of it, and allow it to burn quietly, because the air is not intimately mixed with it, but acts only on the outside, and the quantity of burning matter in the surface of a small flame is too small to produce much effect. But when flame is produced in large quantity, and is properly mixed and agitated with air, its power to heat bodies is immensely increased. It is therefore peculiarly proper for heating large quantities of matter to a violent degree, especially if the contact of solid fuel with such matter is inconvenient. Flaming fuel is used, for this reason, in many operations performed on large quantities of metal, or metallic minerals, in the making of glass, and in the baking or burning of all kinds of earthenware. The potter's kiln is a cylindrical cavity, filled from the bottom to the top with columns of wares: the only interstices are those that are left between the columns; and the flame, when produced in sufficient quantity, is a torrent of liquid fire, constantly flowing up through the whole of the interstices, which heats the whole pile in an equal manner. Flaming fuel is also proper in many works or manufactories, in which much fuel is consumed, as in breweries, distilleries, and the like. In such works, it is evidently worth while to contrive the furnaces so, that heat may be obtained from the volatile parts of the fuel, as well as from the fixed; for when this is done, less fuel serves the purpose than would otherwise be necessary. But this is little attended to, or ill understood, in many of those manufactories. It is not uncommon to see vast clouds of black smoke and vapor coming out of their vents. This happens in consequence of their throwing too large a quantity of crude fuel into the furnace at once. The heat is not sufficient to inflame it quickly, and the consequence is a great loss of heat.

The quantity of watery fluid contained in fuel greatly affects the amount of heat it produces; much more, indeed, than is commonly admitted in practice. It is a well known law of chemistry, that the evaporation of liquids, or their conversion into steam, consumes, and renders latent, a greater amount of caloric. When green wood, or wet coals, are added to the fire, they abstract from it, by degrees, a sufficient part of its heat, to convert their own sap or moisture into steam, before they are capable of being burnt. And as long as any considerable part of this fluid remains unevaporated, the combustion goes on slowly, the fire is dull, and the heat feeble.

Green wood commonly contains a third, or more, of its weight of watery fluid, the quantity varying according to the greater or less porosity of different trees. Nothing is further from true economy than to burn green wood, or wet coal, on the supposition that, because they are more durable, they will in the end prove more cheap. It is true, their consumption is less rapid; but to produce a given amount of heat, a far greater amount of fuel must be consumed. Wood that is dried under cover is better than wood dried in the open air, being more free from decomposition.

WOODS OF THE PALM-TREE.

Two or three varieties only, of the four or five hundred which are said to exist, are imported into this country from the East and West Indies; they are known in England by the names, palm, palmetto, palmyra, and nutmeg, leopard, and porcupine wood, &c., from their fancied resemblances, as when they are cut horizontally, they exhibit dots like the spine, and when obliquely, the markings assimilate to the quills of the porcupine. The trunks of the palms are not considered by physiological Botanists to be true wood; they all grow from within, and are always soft and spongy in the centre, but are gradually harder towards the outside; they do not possess the medullary rays of the proper woods, but only the vertical fibres, which are held together by a much softer substance, like pith or cement, so that the horizontal section is always dotted, by which they may be readily distinguished from all true woods. The colors and hardness of the two parts differ very materially, and I am enabled, through the kindness of Sir James Sutherland, and Colonel Sykes, to give the distinctive names of three.

The *Areca catechu*, or betel-nut palm, is remarkably perpendicular; it grows to the height of about 30 feet, and rarely exceeds 4 or 5 inches diameter: it bears a small tuft of leaves, and the fruit is in clusters like grapes. The betel-nut is chewed by the Indians along with quicklime, and the leaf of the piper betel, in the manner of tobacco. The general color of the wood is a light yellow brown; the fibres are large, hard, and only a few shades darker than the cementitious portions.

The *Cocos nucifera*, or cocoa-nut palm, flourishes the best in sandy spots near the sea-beach; it sometimes grows to 90 feet in height, and 3 feet in diameter, but is generally less; it is rarely quite straight or perpendicular, and has broad pendent leaves from 12 to 14 feet long, in the midst of which is a sort of cabbage, which, as well as the fruit, the cocoa-nut is eaten, the husk of the nut supplies the material for coir-rope, &c. No part of this interesting tree is without its grateful service to the Indian: the leaves are used for making baskets, mats, and the covering of his dwelling; he also obtains from this tree, oil, sugar, palm-wine and arrack; and although the upper part of the trunk is soft and stringy, the lower supplies a useful wood, the fibres of which are of a chestnut brown, and several shades darker than the intermediate substance; the wood is employed for joists, troughs for water, and many purposes of general carpentry, &c. The Asiatic Society has specimens marked, male, 1st, 2nd, 3rd, 4th sorts, and the same number of female varieties; no marked distinction is observable between them.

The *Niépere* palm is much darker than either of the preceding kinds; the fibres are nearly black and quite straight, and the cement is of a dark brown;

but in other varieties with these black fibres, the softer part is very light-colored, and so friable that it may be picked out with the fingers; Colonel J.A. Lloyd informs us, that at the Isthmus of Darien, they use the fibres of some of the palms as nails for joinery-work.

Palmyra-wood, or that of *Borassus flabelliformis*, says Mr. Laird, is largely imported into Madras and Pondicherry, from the Jaffna district at the northern part of Ceylon, for the construction of flat roofs; the joists of which consist of two slabs, the third or fourth part of the tree, bolted together by their flat sides so as to constitute elliptical rafters. They are covered first with flat tiles, and then with a white concrete called *Chunam*, consisting of shell lime, yolks of eggs, and *Jaggree*, (sugar,) beaten together with water in which the husks of the cocoa-nuts have been steeped.

The prickly pole (*Cocos guianensis*) of Jamaica, &c., a palm growing 40 feet high, and of small diameter, is said to be very elastic, and fit for bows and rammers. The palm woods are sparingly employed in England, for cabinet and marquetry work, and sometimes for billiard cues, which are considered to stand remarkably well; they are also turned into snuff-boxes, &c. The smaller kinds are imported under the names of Partridge canes, (called also Chinese or fishing canes,) Penang canes from the island of that name, and some others, for walking-sticks, the roots serving to form the knobs or handles. The knobs of these sticks exhibit irregular dots something like the scales of snakes; these arise from the small roots proceeding from the principal stem, which latter shows dotted fibres at each end of the stick, and streaks along the side of the same.

The twisted palm sticks, are the central stems or midribs of the leaves of the date palm; they are twisted when green, and stretched with heavy weights until they are thoroughly dry: they are imported from the Neapolitan coast, but are considered to be produced in Egypt. The shells of the cocoa-nut and coquilla-nut, and the kernels of the areca or betel-nut, and of the corosos or ivory-nut, have likewise their uses in our workshops.—*Holtzapffel*.

REVIEW.

Sturgeon's Lectures on Electricity. Price 5s. p. 240. London: Sherwood and Co.

We have long wished for the appearance of this book, nor are we disappointed now it has been at length published. It is an excellent and cheap book upon a most interesting subject. It confines itself entirely to the subject of frictional electricity, but we believe, and hope, that its author is preparing other volumes on the chemical, magnetic, and thermometric parts of the science; no one is better able to treat of them, and no books are more wanted; making them to agree with this, full of experiment, and illustration. Mr. Sturgeon is a man whose fame is too well established for him to need our praise; his work is decidedly popular, and does not aim at explaining the science upon mathematical principles; thus, it may be said to form a contrast with all others published of late years, but it contains what they do not, sound practical information told in a plain manner, and rendered, as far as the subject will admit of it, amusing as well as instructive. Having ourselves in the earlier volumes of this magazine treated of this science pretty fully, we are at a loss to choose ex-

tracts; one, however, we will insert, not that it is chosen as one more logical than any other, but because it is a part of electricity which we have somewhat neglected; namely,

LIGHTNING CONDUCTORS.

Mr. Sturgeon writes:—"The subject of lightning conductors is a branch of practical electricity of exceedingly high interest, and demands the contemplations of the most profound electricians. Hitherto, however, little more has been attended to than the erection of a pointed rod of iron, without regard to situation, altitude, diameter, inferior termination, or any of those theoretical points essential to the efficacy and protection of the conductors, so as to render it a safeguard to persons and property against the most formidable element of nature.

Franklin, the inventor of lightning conductors, first proposed 'for protecting houses, churches, ships, &c., from the stroke of lightning, to fix on the highest parts of these edifices upright rods of iron, made sharp as a needle, and gilt to prevent rusting; and from the foot of these rods, a wire down the outside of the building into the ground, or down round one of the shrouds of a ship, and down her side till it reach the water. Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came near enough to strike, and thereby secure us from that most sudden and terrible mischief?"

"This philosopher, however, subsequently recommended continuous iron rods, of about half or three quarters of an inch diameter; which he said 'may be fastened to the wall, chimney, &c., with staples of iron. The lightning will not leave the rod, a good conductor to pass into the wall a bad conductor, through the staples. It would rather, if any were in the wall, pass out of it into the rod, to get more readily by that conductor into the earth. If the building be very large and extensive, two or more rods may be placed at different parts, for greater security. Small ragged parts of clouds suspended in the air between the great body of clouds and the earth, often serve as partial conductors for the lightning, which proceeds from one of them to another, and by their help comes within the striking distance of the earth or a building. It therefore strikes through those conductors a building that would otherwise be out of the striking distance. Long sharp points communicating with the earth, and presented to such parts of clouds, drawing silently from them the fluid they are charged with, they are then attracted to the cloud, and may leave the distance so great as to be beyond the reach of striking. It is therefore that we elevate the upper end of the rod six or eight feet above the highest part of the building, tapering it gradually to a fine sharp point, which is gilt to prevent its rusting. Thus the pointed rod either prevents a stroke from the cloud, or if a stroke be made, conducts it to the earth with safety to the building. The lower end of the rod should enter the earth so deep as to come at the moist part, perhaps two or three feet; and if bent under the surface so as to go in a horizontal line six or eight feet from the wall, and then bent again downwards three or four feet, it will prevent damage to any of the stones of the foundation.'

"Such were the instructions of the celebrated Franklin; and had he recommended copper rods instead of iron, and directed them to be kept clear of the building instead of being fastened to the walls 'with staples of iron,' perhaps no better instructions

could have been given; as far, at least, as an individual rod is concerned. But besides the injury that buildings may receive from a flash of lightning striking a conductor fixed close to the slates and masonry, from lateral explosions, a conductor consisting of a single branch only might be the means of drawing down destruction to some parts of the building before the lightning reached that conductor. For, were the lightning cloud on one side of the building, and the conductor on the other, the lightning would neither go round nor over the house to arrive at the conductor, unless it met with greater resistance in a direct path, and as the destination of lightning is frequently a great distance from the cloud, and its path considerably oblique, it is possible that some part of its path might be through a part of the building before it arrived at a lightning rod which formed another part of its path.

"Cases of this kind have occurred, and consequently, may possibly occur again under similar circumstances; therefore it seems to me that unless lightning conductors be properly placed, and of proper materials and dimensions, they may be the means of causing the most destructive consequences to those buildings they were intended to protect. It is very seldom indeed that a flash of lightning proceeds in a vertical path: perhaps never. I never yet saw, or heard of a vertical discharge of lightning; they are frequently very oblique indeed. The lightning which damaged St. Michael's Church at Liverpool, last year, was an oblique discharge, and struck the bronze cross at the top of the spire, several feet from its top.

"There is such a display of ignorance in the erection of tall spires, that it is almost a miracle that the whole of them are not destroyed by lightning. The copper clamps and strings of lead, the former uniformly placed at intervals from each other, and the latter wantonly poured into the crevices of the masonry, render the spire a complete chain of alternate links of metal and masonry from top to bottom; the former inviting the lightning to the edifice, and the latter offering facilities for the most destructive explosions. From this very arrangement of the materials in the steeples of St. Michael's and St. Martin's at Liverpool, and in the steeple of Brixton Church, have these three steeples been shattered by lightning. If such modes of building tall spires be indispensable to protect them from the power of the wind, conductors are quite as indispensable to protect them from lightning. Three copper rods at equal distances from one another, from the top of the spire to the ground, and united at the top, and by one or two bands below, would secure each spire from lightning on whichever side it approached. Lightning rods, however numerous about a building, should have a general metallic union; they then form a system of conductors in which the force of the lightning would be divided, whichever branch was struck.

"Marine lightning conductors, or those employed on board of ships, are simply chains of copper, formed of links similar to those of the surveying chain, and are hoisted to the mast head when there is an appearance of lightning striking the ship. But the lightning has frequently struck ships before the chain could be got up; showing the propriety of having a permanently-attached conductor, which would always be ready to receive and carry off the flash. Such fixed conductors have been proposed, and some are now on trial in the navy; but, singular enough, these conductors instead of carrying the

lightning overboard, would lead it into the body of the ship, and should they ever happen to be struck with a powerful stroke of lightning, the consequences might be terrible indeed.

"The idea of carrying a conductor through the body of the ship originated with Mr. Benjamin Cook, of Birmingham, about the year 1811, but it has been carried out by Mr. Harris, of Plymouth. Mr. H. has formed the conductors into strips of copper, which are inserted in grooves in the after side of the masts, from top to bottom, and through the keelson to the sea. In one of the smaller men of war Mr. H. carried his mixzen conductor through the powder magazine. The evils attending these conductors, arise principally from lateral explosions, and electro-magnetic influence.

"Imagine a chronometer to be placed near to a conductor carrying a heavy flash of lightning; the main and pendulum springs, the chain, arbors, and in fact every morsel of steel, would be rendered permanently magnetic, and consequently the machine rendered entirely useless: and the same fate would attend every chronometer and watch within the sphere of the electro-magnetic influence, which, in such cases, would be very extensive, and on every side of the conductor.

"The lateral discharges are of three kinds, which I have distinguished, 1st, 2nd, and 3rd, one of which I have already shown you, by the spreading abroad the grains of gunpowder, seeds, &c., and by the breaking of glass and other hard substances. These are the first kind, and take place at every interruption in the circuit.

"The second kind of lateral discharge, specimens of which I shall now offer to your notice, occurs in the most perfect conducting circuit, unless the conductor be perfectly free from asperities, sharp edges, angles, &c. I shall endeavour to illustrate this kind of lateral discharge by a few decisive experiments. A thick copper wire, bent at various places into angles, is suspended in the room, and I transmit a discharge of the battery from a high intensity through this wire. The room being darkened, the discharge takes place; and you will have observed that at every angle in the wire a brush of electric light sprang into the air.

"I will now make a new circuit for the next discharge of the battery to traverse. In this circuit I place a strip of sheet copper about a foot long, in imitation of the copper conductors in masts. On making the discharge, both edges of the copper, from top to bottom, throw out fringes of electric fluid; which is a clear proof that in every discharge of lightning on to such conductors, an immense portion would issue from their edges, from the highest point of the mast to the step in the hold of the vessel. Of the consequences of such lateral discharges in the hold of a ship I must leave others to judge. The third kind of lateral discharge takes place even from the best polished conductors under certain circumstances, and arises from the polarizing influence of the electric fluid whilst in motion.

"But the most splendid series of experiments in illustration of electric waves, and of the lateral explosion at the same time, were made by Mr. Weekes, of Sandwich, on the 19th of May, 1841. This indefatigable philosopher had a stout copper wire suspended between the steeples of two churches, over a part of the town of Sandwich, and from this wire another descended to his laboratory, and ready to be

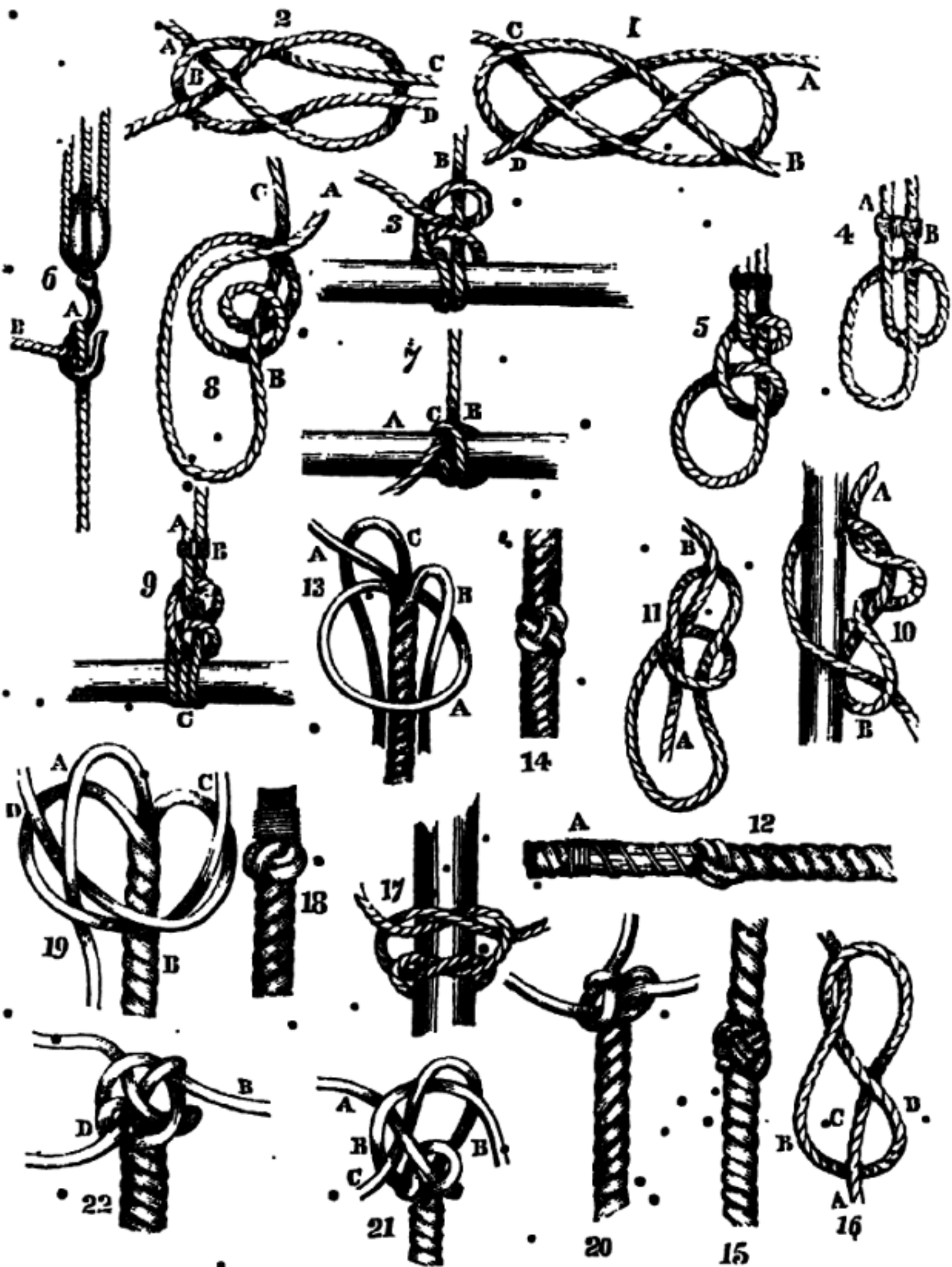
attached to any piece of apparatus with which he was about to make experiments. In compliance with the rules which I have shown you for illustrating this kind of lateral explosion, Mr. Weekes arrayed his apparatus in the most suitable manner for obtaining brilliant results; which, were most amply displayed on the 19th of May last. A black cloud passed over the town, and flashes of lightning were seen, but no direct discharge ever touched the apparatus; nevertheless, 'a mighty torrent of dense sparks, so vivid as to dazzle the eye of the observer, attended by contemporaneous stunning reports, and fraught with an unusual intensity, rushed from the terminus to the ball in communication with the earth,' though 'separated to a distance of 3 and $\frac{1}{2}$ inches.' At the same identical moment, a furious current of lateral sparks took place between the wire and the leaden spout of the pump.' Such is Mr. Weekes's own description of the first part of the electrical drama.

"But now comes to be described the most resplendent feature of the scene before us; the iron nail, serving to connect the pump machinery, suddenly exhibited the appearance of a magnificent firework, the splendor of which was repeatedly enhanced as waves of electric fluid rushed through the arrangement, in obedience to each successive lightning flash from the storm cloud, and this sublime scene, with short intervals of lesser energy in the electric current, continued through the space of one hour and sixteen minutes. The combustion of the iron nail forcibly reminded me of the appearance which that metal exhibits when burnt in oxygen gas, or rather when brought under the influence of the oxy-hydrogen blow-pipe, though the phenomenon was accompanied by a deep red kind of light, which does not belong to either of these comparisons.

"The iron nail which deflagrated so splendidly was absolutely in the circuit, and that circuit completely metallic down to the bottom of the pump pipe in the well of water; the phenomenon was, therefore, a lateral discharge. The other lateral discharges which Mr. Weekes observed were of the third kind. These he took from every part of the wire, pump, and other parts of the conducting circuit, many of which were productive of powerful shocks. A young lady, who accidentally stepped on the wire, received a lateral discharge which sent her 'reeling across the laboratory.'

"Such facts as were developed in this series of experiments, and many others on record, and especially those of M. De Romas, made with an electric kite on the 7th of June, 1753, in which immense torrents of the electric fluid streamed down the string though never struck by lightning, are not only necessary to be borne in mind by every kite experimenter, but should ever be kept in view by projectors of lightning conductors.

"The electro-magnetic action of lightning is also an essential consideration, especially on board of ship; and if it were on no other account, this alone is of sufficient importance to discourage the idea of carrying a lightning conductor through the body of the vessel. Marine lightning conductors should always be so placed as to carry the lightning overboard, and not so as to entice it into the vessel. Hence it is that even the usual chain conductors, if got to the mast-head, in time, are a greater protection to the vessel than any conductor that would lead the lightning into the hold."



SAILOR'S KNOTS, BENDS, AND HITCHES.

SAILOR'S KNOTS, BENDS, AND HITCHES.

SAILORS distinguish all foldings and fastenings of ropes into the various terms, bend, hitch, knot, and splice, and we may, perhaps, usefully employ a page of the present number in describing the chief distinctions and varieties of these different operations.

A *bend* is a particular knot by which one rope is fastened to another, or by which a rope is fastened to another object, as an anchor, mast, &c.

Bends are of various kinds and denominations; such as the *Carrick-bend*, the *sheet-bend*, the *fisherman's-bend*, &c.

Fig. 1. Carrick bend.—To make a carrick-bend, lay the ends of a rope A and B, then pass it through the bight, under D, and up through the bight C.

Fig. 2. Sheet bend.—To make a sheet-bend; pass the end of a rope A, through the bight of another rope B, then round both parts of the rope CD, and down through its own bight.

Fig. 3. Fisherman's bend.—To make a fisherman's-bend; with the end part of a rope take two turns round a spar, a half-hitch round the standing part B, and under the turns A, then another half-hitch around the standing part B. This is used for bending the studding-sail halyards to the yard.

A *hitch*, in its general explanation, differs in no respect from the bend, but may be defined in the very same words, as a knot whereby ropes are fastened to each other, or to some other body. The names of the various hitches are as follows:—

Fig. 4. To hitch a rope is to pass its end A, round the standing part, then bring it up through the bight, and fasten it to the standing part at B. This is called a *half-hitch*; and two of these, one above the other, *Fig. 5*, is called a *clove-hitch*.

Fig. 6. Blackwall hitch, is made by putting a bight of a rope over the hook of a tackle and letting the part A rest upon it, and the part B be jammed by the standing part at the cross. This is used with a landyard, when setting up the shrouds.

Fig. 7. Magnus hitch is made by passing two round turns with the end of a rope over a spar A, then bringing it before the standing part B, passing it again under the spar, and up through the bight which it made the end part, being jammed by the bight C.

Fig. 8. A midshipman's hitch is made by taking a half-hitch with the end of a rope A, round the standing part B, then taking another turn through the same bight, jamming it between the parts of the hitch: when hauled taught the end may be taken round the standing part at C, or stopped to it. It is in this manner a tail-tackle is clapped on a rope or fall, to augment the purchase.

Fig. 9. A rolling hitch is made in the following manner:—With the end of a rope, as represented at A, take two round turns over the spar, &c. at C, then pass two half-hitches (see *Fig. 4*.) round the standing part B, and it is finished: the end may be stopped to the standing part.

Fig. 10. A timber hitch is made by taking the end of a rope A, round the spar, or timber head, leading it under and over the standing part B, and passing several turns round its own part C.

A *knot* is a large loop, formed on the extremity of a rope, generally by untwisting the ends thereof, and interweaving them regularly amongst each other; there are several sorts of knots, which differ in their form, size, and name, according to the uses for which they are designed; as

Fig. 11. Bowline knot is made by laying the end

of a rope A, over the standing part B, and turning a bight over the standing part; then leading the end round the standing part, through the bight again. When this knot is drawn close, it makes a loop; and when fastened to anything it will never slip.

Fig. 12. Buny-rope knot is made by unlaying the strands of the cable-laid rope, and also one of the small strands out of each large one; laying the large ones again as before, and leaving the small ones out; then single and double wall the small strands (as directed for the stopper-knot, *Fig. 18*.) round the rope, worm them along the divisions, and stop their ends with spun-yarn, A.

Fig. 13. Diamond knot is made by unlaying the end of a hawser-laid rope for a considerable length, and with the strands form three bights down its side, holding them fast. Put the end of the strand A, over the strand B, and through the bight of the strand C, as represented in the figure: then put the strand B over the strand C, and through the bight formed by the strand A; and the end C over A and through the bight of B. Haul these taught, lay the rope up again, and the knot will appear like *Fig. 14*.

Fig. 15. Double diamond-knot is made with the strands opened out again, following the lead of the single knot through two single bights, the ends coming out at the top of the knot, and leading the last strand through two double bights: then, by laying the rope up again as before to where the next knot is to be made, it will appear like *Fig. 15*.

Fig. 16. Over-hand or figure of eight knot is made by taking the end of a rope A round the standing part B, under its own part D, and through the bight C.

Fig. 17. Reef knot is made by, first forming a rope into an over-hand knot (see *Fig. 16*.) round a yard or spar; bringing the end in the right hand over to the left, and the left to the right; then take the right hand end round the left, and draw them taught, and it will appear like *Fig. 17*.

Sheep-shank knot serves to shorten a rope without cutting it, which may be presently loosened, and the rope not the worse for it. It is merely tying a knot upon a double rope.

Fig. 18. Stopper knot is made by single walling and double walling, without crowning, a three-stranded rope against the lay, and stopping the ends together as is represented by *Fig. 18*. If the ends are very short they should be whipped, without being stopped.

Fig. 19. Single wall knot is made by unlaying the end of a rope, and with the strand A form a bight, holding it down on the side of the rope at B; passing the end of the next C round the strand A; the end of the strand D round the strand C, and through the bight which was made at first by the strand A; then haul them rather taught, and the knot will appear like *Fig. 20*.

Fig. 21. To crown the single wall knot is to lay one of the ends over the top of the knot, which call the first A, lay the second B over it, and the third C over B and through the bight A; haul them taught, and the knot with the crown will appear like *Fig. 22*, which is drawn open, in order to render it more clear. This is called a single wall, and single crown, from which the double wall and double crown knots are easily made.

The knots are generally used to act as a button, in preventing the end of a rope from slipping through an eye, or through the turns of a landyard, by which they are sometimes made fast to other ropes.

To *splice* is to join the two ends of a rope to any part thereof, by interweaving the strands in a regular manner. There are several methods of making a splice, according to the services for which it is intended; all of which are distinguished by particular epithets, as •

Short splice is made by untwisting the ends of two ropes, or the ends of one rope, and, having placed each of the strands of one opposite to and in the interval between two strands of the other, to draw them close together; and then interweave the strands of one into the alternate strands of the other, by penetrating the latter with a fid or marline-spike, parallel to the axis or length of the rope. This splice is used on the cables, slings, block-straps, and in general all ropes which are not intended to run through blocks, or where the splice is not in danger of being loosened or separated.

Long splice occupies a greater extent of the rope; but, by the three joinings being fixed at a distance from each other, the increase of bulk is also divided; hence it is much neater and smoother than the short splice, and better adapted to run through the channel of a block, &c. for which use it is generally calculated.

Eye splice forms a sort of eye or circle at the end of a rope, and is used for splicing in thimbles, bull's eyes, &c. and sometimes on the ends of block straps: the strands are, therefore, untwisted and their extremities thrust through the three strands in that part of the rope whereon the splice is to be formed, and thence passing over the surface of the second strand, they are again thrust through the third, which completes the operation.

ON LATENT LIGHT.

BY PROFESSOR MOSER.

(Abridged from Poggendorff's *Annalen*.)

In the following, I intend to prove that there is a latent light as well as a latent heat; that they both are produced under similar circumstances, and when under the same influences pass into a free state; and that when a body alters its state of aggregation, we cannot any longer regard this as produced by heat alone; light also takes an active part in the process.

The most general definition of light which I should be inclined to propose for the present is this:—that by light the surfaces of all bodies are modified, so that they condense vapours otherwise than usual. A plate of iodized silver, which has undergone the action of light in a camera obscura, and has afterwards been exposed to mercurial vapours, furnishes a very simple example of this definition. If the precipitation of vapours produces effects similar to those of light, we are justified in assuming a latent light belonging to the vaporized state, just as from an evolution of heat under similar circumstances we adopt a latent state of that power. For the present all that remains to be shown is, how the reversed process, evaporation, produces effects of light; and this I have observed on evaporating water, alcohol and æther. I employed plates of silver, gold, copper, German silver, and glass; we may, however, evaporate fluids of any superficial extent, if they only produce small permanent changes, and we are able to write down, as it were, the effects which have taken place. Experiments of this kind, to succeed well, are by no means easy of execution; even distilled water readily leaves traces on well-polished bodies, particularly when employed in large

quantities; but I succeeded in obtaining incontrovertible results in the following manner:—I dipped a small thermometer-bulb into distilled water and wrote upon a plate with the adhering drop, but so that the bulb itself did not touch. It is possible to perform the experiment so that the water is deposited on the plate in a concrete form only in some places, while it has passed over the greater part merely as a breath of vapour, which, however, is quite sufficient for these experiments. Or the trial may be made thus:—Strips of hybulous paper are fixed on to any convenient body and moistened with a very little distilled water; the polished surface is then touched for a moment with these strips, which is also quite sufficient. If, however, the evaporating liquid should leave some traces behind, as is generally the case with alcohol and æther, but in the case of water arises chiefly from the pulverulent matters employed in the polishing, then these spots may be carefully rubbed off. It is also as well to perform the operation under a damp cloth. After a silver plate has been exposed to the action of the evaporating water, alcohol, or æther, it is to be exposed to the vapours of water, mercury, or iodine, or to those of hydrochloric acid, chloride, or bromide of iodine, &c.; in all cases a perfectly distinct picture is produced: in the aqueous vapours it is generally the strongest, in mercury it appears only after a long action, and in vapours of iodine it is often very faint. But even in this case it is only necessary to expose the plate to daylight in order to obtain a strongly marked image. If any other metals besides silver have been employed for evaporating the fluids, it is only necessary to expose them to any of the above-mentioned vapours in order to obtain good pictures. I will moreover mention, that if we allow hot water to evaporate from a Daguerre's picture as it is taken out of the camera obscura, the image is completely destroyed. This is caused by a process of light, as will be seen from the following paragraphs.

It is therefore evident that evaporation produces phenomena similar to those of light, just as well as the condensation of vapours; and I leave it for experimental philosophers to extend the result to the passage of a solid state of aggregation into a fluid one, and *vice versa*, and to take into consideration these transitions, both as respects to the processes of light and those of heat. As the matter is so new and of so much importance, I may be permitted to draw attention to the fact, that (remaining within the limits of what has been empirically proved) if we have a vapour of a certain elasticity and temperature, and any plate also of a determinate temperature, the condensation of the vapour is not found at once, but it depends upon those actions of light to which the plate has been exposed. This state of the matter is not sufficiently advanced to prove what influence light has in the change of the state of aggregation. Although a silver plate, *e. g.* has the same temperature in every part, still the aqueous vapours will be condensed, either in a greater or less degree, by certain portions of it, according to the action of light which these parts undergo.

The same holds good with regard to the condensation of the vapours of mercury, iodine, chlorine, &c.; it depends as much upon light as upon heat, and it is evident, from the difference of those vapours which I have examined, that such a result is of general application. For instance, although aqueous vapours are precipitated very readily on plates of silver, they evaporate again just as quickly, and

exhibit very small or no adhesion. The vapours of mercury adhere permanently, for the images of Daguerre do not exhibit any perceptible change even after a length of time. But what is very peculiar in this respect is, that they do not seem to combine with the mass of the silver, or with that of gold, or even zinc, while mercury in a fluid form exhibits so great an affinity for these substances. Vapours of iodine combine chemically with the silver. Notwithstanding, then, that these vapours behave so differently in certain respects, they still agree together in one point, viz. that their condensation is influenced by light just as much as by heat. Indeed we should have been able to draw this conclusion from the Daguerre's pictures alone, if we had a correct insight into the process which produces them.

I will now proceed to the interesting question concerning the color of latent light. The determination of this point is as important as it is difficult, and I have only succeeded after many attempts with some kinds of vapours, but in these cases in a manner that promises sufficient security. This examination is important, inasmuch as one might easily be induced to advance facts as objections to that correct statement, that the condensation of vapours has an action similar to that of light; while, if we consider them from the proper point of view, viz. that the various kinds of vapour contain different colored latent light, we find in them the strongest confirmations of the proposition.

It was now not to be doubted that each species of vapour retained a peculiar kind of light in combination, either rays of a simple color, or of several, but combined in a definite proportion. After this point had been settled, I soon became convinced that what we as yet know of the action of the different colors of the spectrum is quite insufficient for determining with safety the latent color of even one vapour. Our knowledge is not insufficient because too few substances have been examined with regard to their behaviour towards light; on the contrary, I believe that there is still sufficient to be studied in one substance, viz. iodide of silver; and I know only one question, to be hereafter mentioned, which I do not think can possibly be answered by iodide of silver alone, but requires the test of other kinds of matter. I shall therefore principally make use of this substance, and I consider the solution of the following problem as the groundwork for every further step in this new sphere, viz. as far as regards the determination of latent color. This problem is—“light has exerted its influence upon iodide of silver; whether it be visible outwardly or not, it is required to find by which color this action was produced.”

I have not succeeded in exhausting this proposition; but I think that I have advanced some steps towards its solution, which already lead to remarkable results. The influence of the differently refrangible rays on iodide of silver is, that the blue and violet rays commenced and continued the action until the iodide was blackened. This is a fact which, in the case of chloride of silver, has been known since the time of Scheele. E. Becquerel made the additional discovery that the red rays cannot indeed commence the action, but are capable of continuing it when once begun, and can carry it on even until blackening ensues. Finally, I had stated that the yellow and green rays restore the blackened iodide of silver to its primitive colored state; consequently, the groups of colors, which for the sake of brevity may be denominated blue, red and yellow, exhibit qualitative differences in their action upon iodide

of silver, and this action cannot be brought into connexion with the refrangibility (or more correctly the length of oscillation), which is a very remarkable circumstance; for the action is begun by the most, continued by the least refrangible rays, and carried on still further by those possessed of a medium index of refraction. On further consideration, this appeared to be very incredible, and I shall now show that the idea was quite erroneous.

The reality is, that the rays of every degree of refrangibility all act similarly on the iodide of silver, and there is no positive result which cannot be obtained by rays of all kinds. The only true difference is, that in order that the same action should be produced by the various rays, it is necessary to employ different times, and in such a manner, that if the action, measured in any manner, be represented as a function of the time, this function will have different forms for the different colors. As a proof of this proposition, I will first mention, that the iodide of silver may be blackened by colored glasses of all kinds. In this respect there can be no doubt with regard to the violet, blue, green, yellow, and orange glasses. I have had opportunities of examining a great number of them, and when the operation was performed in the sun, the action was never long in making its appearance. The only uncertainty might be with regard to the red glasses. I have some of these, in experimenting with which, I thought I observed that they retained the iodide of silver in its original coloring, and were not capable of commencing the action. On further examination, however, I found that this depended on the manner in which I had previously made the experiments, inasmuch as I had laid a uniformly red colored glass on the iodized silver plate. In such circumstances it is difficult to observe the slow action of these glasses. But if any drawing be made on these glasses, by rendering certain parts non-transparent, it will then be seen that they are capable of commencing the action just as much as the others, although indeed not so rapidly. My friend M. Dulk succeeded just as ill in some experiments that he made. He believed that chloride of silver does not undergo any blackening under a dark red bell jar, even after the lapse of several days; but, when I introduced into this jar an iodized plate, situated behind a screen, a perfect picture of the excised part was produced in a few hours. All colors then agree with the blue in having the power of commencing the action, and of continuing it until blackening ensues, although the periods required are very different.

(To be continued.)

SIGNS OF INCREASE, MATURITY, AND DECAY IN TREES.

THE qualities of wood depend much on the state of the tree when cut down. It appears, from the experiments of M. Hartig upon wood applied as fuel, that trees which have attained maturity without passing into decay, are the best for the production of heat. Thus the value of an elm of one hundred years is to that of one of thirty years, as twelve is to nine; that of an ash of one hundred years to one of thirty years, as fifteen to eleven. When the trees begin to decay, their value rapidly diminishes; thus, if an oak of two hundred years yields wood worth 15 shillings per corde, a tree of the same kind passing to decay yields wood only worth 12 shillings. When the wood is used for other purposes, the advantages conferred by a mature but healthy state are more considerable.

The common elm, growing in a forest and in good earth, acquires its full increase in about one hundred and fifty years, but it will live many ages, even five or six hundred years. Large forest elms are cut down with advantage when of an age between one hundred and one hundred and thirty years, and then furnish a large quantity of building wood. The duration of the life of an elm depends much upon the soil; in a dry soil it becomes aged, as it were, in forty, fifty, or sixty years. Elms which have been lopped, live for a shorter period than the others. Those which grow by the road side, or in thin plantations, may be cut when seventy or eighty years of age. In general, the increase of hard woods, as the oak and the elm, is small at first; it successively augments until the twentieth or twenty-fifth year, is then uniform until the age of sixty to eighty years, after which it sensibly diminishes. For these and other reasons, it is important that trees should be cut down when they are at their mature state, and not simply when they undergo no further increase. When the period has arrived after which the increase of the tree would be less and less from year to year, then the tree should be felled, for no advantage accrues from its remaining longer in the ground. The indications of the mature state of a tree are by no means so evident as those of decay, but still certain signs of these states, as well as of the vigorous condition of the tree, may always be observed.

1. *Signs announcing the vigor of a tree.*—The branches, especially towards the top, are vigorous; the annual shoots strong and long; the leaves green, vigorous, and thick, principally at the summit, and falling late in autumn; the bark is clear, fine, united, and nearly of the same color from the foot to the large branches. If at the bottom of the veins, or divisions, of the thick bark, there appear smaller divisions which follow from below, upwards, in the direction of the fibres, and live bark be observed at the bottom of these divisions, it is an indication that the tree is very vigorous and rapidly increasing in size. If some of the lower branches, stifled by the others, are yellow, languishing, and even dead, this is an accidental effect, and is no proof of the languor of the tree. Finally, it is a sign of vigor when branches are seen at the summit of the tree, rising above and being much longer than the others; but it is to be observed that all trees with round heads do not throw out branches with equal force.

2. *Signs that indicate that the tree is mature.*—Generally the head of the tree is rounded; the shoots diminish in length each year, and the furthest shoots add to the length of the branches only by the length of the bud; the leaves are put forth early in spring and become yellow in autumn before those of vigorous trees, and at this time the lower leaves are greener than the upper. The branches incline towards the horizon, and form angles sometimes of sixty or seventy degrees. These apparent signs, and the thinness of the layer deposited by the sap, indicate that the tree makes but small additions to itself, and now it should be cut down. The nature of the earth should be examined, as well as the kind of tree, to form a judgment whether the tree should be left to increase still further, or whether it will be more proper to fell it. An exact age cannot be assigned for each species, but it has been observed, that an elm situated in an insulated plantation may be felled with advantage when between seventy and eighty years of age.

3. *Signs of decay in a tree.*—When a tree becomes crowned, i. e. when the upper branches die,

it infallibly indicates, especially for isolated trees, that the central wood is undergoing alteration, and the tree passing to decay. When the bark separates from the wood, or when it is divided by separations which pass across it, the tree is in a considerable state of degradation. When the bark is loaded with moss, lichen, or fungi, or is marked with black or red spots, these signs of alteration in the bark justify suspicions of alterations in the wood within. When sap is seen to flow from clefts in the bark, it is a sign that the tree will soon die. As to wounds or gutterings, these defects may arise from local causes, and are not necessarily the result of old age.

FROST.

Frost is the name we give to that state of our atmosphere in which water is changed into ice. The degree of temperature at which this takes place is called the freezing point. The cold air draws from water the portion of caloric which is necessary for its existence in a fluid state. The power of frost is immense; a freezing liquid will burst the strongest vessels in which it is inclosed. Organic bodies do not suffer so much from it, and many are entirely unhurt by it. Severe frosts are not so injurious to plants, after dry weather, as when they follow immediately after rain or a thaw. The cause of this probably is, that in damp weather, even in winter, the tender vessels of plants are filled with sap, which, expanding into ice at the time of the frost, breaks them, and thus injures their whole internal organization. From the same cause, the strongest oaks split in a severe frost; which is also dangerous, and sometimes fatal to men and animals. It appears wholly to destroy the irritability of the bodily frame, and to rob it of its internal heat. A person feels an irresistible inclination to sleep; he yields, though against his will, and while lost in insensibility, his limbs begin to stiffen. If a man thus asleep be brought into a warm room, the sudden passage from cold to warmth causes his death; but if he be rubbed in the snow he may recover. The same is the case with regard to the frozen limbs of men and animals, which can only be saved by being gradually thawed, especially in snow. Frost is also very injurious to certain kinds of food. All watery fruits are deprived by frost of their pleasant taste and their nourishing properties, and soon grow rotten after being thawed. Even meat, which appears to be preserved from tainting by the frost, corrupts soon after thawing. Liquids, as beer, for instance, lose their good taste. Violent winds always diminish the coldness of the air. Many fluids expand by frost, as water, which expands about one-tenth part, for which reason ice floats in water; but others, again, contract, as quicksilver, and thence frozen quicksilver sinks in the fluid metal.

Frost, being produced by contact with the atmosphere, naturally proceeds from the external parts of bodies inwards; so, the longer a frost is continued, the thicker the ice becomes upon the water in ponds, and the deeper into the earth is the ground frozen. In about sixteen or seventeen days' frost, Mr. Boyle found it had penetrated fourteen inches into the ground. At Moscow, in a hard season, the frost will penetrate two feet deep into the ground; and Captain James found it penetrated ten feet deep in Charlton island; and the water in the same island was frozen to the depth of six feet. Scheffer assures us, that, in

Sweden, the frost pierces two cubits, or Swedish ells, into the earth, and turn what moisture is found there into a whitish substance like ice, and penetrates standing water to three ells or more. The same author also mentions sudden cracks or rifts in the ice of the lakes of Sweden, nine or ten feet deep, and many leagues long, the rupture being made with a noise not less loud than if many guns were discharged together. By such means, however, the fishes are furnished with air, so that they are rarely found dead.

The natural history of frosts furnishes very extraordinary results. The trees are often scorched and burnt up, as with the most excessive heat, in consequence of the separation of water from the air, which is therefore very drying. In the great frost in 1683, the trunks of oak, ash, walnut, &c., were miserably split and cleft, so that they might be seen through, and the cracks were often attended with dreadful noises, like the explosion of fire-arms. The close of the year 1708, and the beginning of 1709, were remarkable, throughout the greater part of Europe, for a severe frost. Doctor Derham says it was the greatest in degree, if not the most universal, in the memory of man; extending through most parts of Europe, though scarcely felt in Scotland or Ireland. In very cold countries, meat may be preserved by the frost six or seven months, and proves tolerably good eating. In Hudson's Bay the frost seems never out of the ground, it having been found hard frozen in the two summer months. Brandy and spirit, set out in the open air, freeze to solid ice in three or four hours. Lakes and standing waters, not above ten or twelve feet deep, are frozen to the ground in winter, and all their fish perish. But in rivers, where the current is strong, the ice does not reach so deep, and the fish are preserved.

THE ALGÆ, OR SEA-WEEDS.

Those who have ever examined the surface of stones constantly moistened by water, the glass of hot-houses, the face of rocks in the sea, or of walls where the sun never shines, or the hard paths in damp parts of gardens after rain, cannot fail to have remarked a green mucous slime with which they are covered. This slime consists of Algæ in their simplest state of organization, belonging to the genera *Palmella*, *Noctec*, *Red Snow*, and the like. Bory de St. Vincent's account of them is to the following effect:—The slime resembles a layer of albumen spread with a brush; it exfoliates in drying, and finally becomes visible by the manner in which it colors green or deep brown. One might call it a provisional creation waiting to be organised, and then assuming different forms, according to the nature of the corpuscles which penetrate it or develop among it. It may further be said to be the origin of two very distinct existences, the one certainly animal, the other purely vegetable. This matter lying among amorphous mucus consists in its simplest state, of solitary, spherical corpuscles; these corpuscles are afterwards grouped, agglomerated, or chained together, so producing more complex states of organisation. Sometimes the mucus, which acts as the basis or matrix of the corpuscles, when it is found in water, which is the most favorable medium for its development, elongates, thickens, and finally forms masses of some inches extent, which float and fix themselves to aquatic plants. These masses are at first like the spawn of fish, but they soon change color and become green, in consequence of the formation of interior vegetable

corpuscles. Often, however, they assume a milky or ferruginous appearance; and if in this state they are examined under the microscope, they will be found completely filled with the animalcules called *Naviculariæ*, *Lunulinæ*, and *Stylariæ*, assembled in such dense crowds as to be incapable of swimming. In this state the animalcules are inert. Are they developed here, or have they found their way to such a nidus, and have they hindered the development of the green corpuscles? Is the mucus in which they lie the same to them as the albuminous substance in which the eggs of many aquatic animals are deposited? At present we have no means of answering these questions. According to Gaillon, many of these simple plants are certainly nothing but congeries or rows of the singular and minute animalcules called *Vibrio tripunctatus* and *bipunctatus* by Muller, strung end to end.

Another form of Algæ, one which may be considered a higher degree of development of the last, is that in which they assume a tubular state, containing pulverulent or corpuscular matter in the inside, and become what are called *Conservæ*. The general character of *Arthrodiæ* consists in filaments, generally simple, and formed of two tubes, of which one, which is exterior and transparent, offers no trace of organisation to the most powerful eye, so that it might be called a tube of glass, and contains an inner articulated filament filled with coloring matter, often almost imperceptible, but at other times very intense green, purple, or yellowish; these compound filaments present to the astonished eye the strangest and most different phenomena, all of which have the plainest characters of animal life, supposing that animal life is to be inferred from motions indicating a well-marked power of motion. The *Arthrodia* tribe usually inhabits either fresh or sea-water, and several species are common to both. One of them, but a species referred to the tribe with some uncertainty, the *Conserva oricetorum*, grows on the ground, but in places that are very damp, and often inundated; others among the *Oscillating* species cover the humid surface of rocks or earth, and the interstices in the pavement of cities; some even grow in hot springs of a very high temperature. The most remarkable are, 1st. The *Fragillariæ*, to which *Diatoma* and *Achnanthes* belong; these, when combined in the little riband-like threads which are natural to them, have no apparent action; but as soon as the separation of the joints takes place, a sort of sliding or starting motion may be seen between them. 2dly. The *Oscillariæ*, some of which have an oscillatory movement, extremely active and perceptible; and the *Ulva labyrinthiformis* and *Anabaina*, which, with all the appearance of a plant, has, according to Vanquelin and Chaptal, all the chemical characters of an animal. 3dly. The *Conjugatæ*, the filaments of which separate at one period, and unite again at another, and finally, by a mode of coupling completely animal, resolve themselves into a single and uniform being; and, 4thly. The *Zoocarpæ*, most extraordinary productions, in which the animal and vegetable natures follow each other in the same individual; vegetables in the earlier period of their existence, but producing, in the room of spores or buds, little microscopic animalcules, which become filamentous vegetables after a certain length of time.

Other Algæ approach nearly to the structure of Lichens, lose entirely their animal properties, and become broad flat expansions, or finely divided vegetables, such as are seen in the ordinary state of

sea-weeds, Fucl, or marine Conserve. Of the British species of these, and their general nature, an excellent account has been given by Greville in his *Alge Britannice*, from which the greater part of the following remarks are extracted. "While the two first groups consist of microscopic objects inhabiting obscure places, shady paths, or half-immersed surfaces of stones and banks, the more complete Alge comprehend species forming subaqueous forests of considerable extent in the vast ocean, emulating in their own gigantic dimensions the boundless element that enfolds them. *Chorda filum*, a species common in the North Sea, is frequently found of the length of 30 or 40 feet. In Scalpa Bay, in Orkney, according to Mr. Neill, this species forms meadows, through which a pinnace with difficulty forces its way. *Lessonia fuscescens* is described by Bory de St. Vincent as 25 or 30 feet in length, with a trunk often as thick as a man's thigh. But all these, and indeed every other vegetable production, is exceeded in size by the prodigious fronds of *Macrocystis pyrifera*. This appears to be the sea-weed reported by navigators to be from 500 to 1500 feet in length; the leaves are long and narrow, and at the base of each is placed a vesicle filled with air, without which it would be impossible for the plant to support its enormous length in the water; the stem not being thicker than the finger, and the upper branches as slender as common packthread."

Properties.—For what wise purpose the Creator has filled the sea and the rivers with countless myriads of these plants, so that the Flora of the deep waters is as extensive as that of dry land, we can only conjecture; the uses to which they are applied by man are, doubtless, of but secondary consideration; and yet they are of no little importance in the manufactures and domestic economy of the human race. Greville describes them in his *Alge Britannice* thus:—

"*Rhodomenia palmata*, the dulse of the Scots, dilleek of the Irish, and saccharine *Fucus* of the Icelanders, is consumed in considerable quantities throughout the maritime countries of the north of Europe, and in the Grecian Archipelago; *Iridaea edulis* is still occasionally used, both in Scotland and the south-west of England. *Porphyra laciniata* and *vulgaris* is stewed, and brought to our tables as a luxury under the name Laver; and even the *Ulva latissima*, or green Laver, is not slighted in the absence of the *Porphyra*. *Entesomorpha compressa*, a common species on our shores, is regarded, according to Gaudichaud, as an esculent by the Sandwich Islanders. *Laurentia pinnatifida*, distinguished for its pungency, and the young stalks and fronds of *Laminaria digitata* (the former called Pepperdulse, the latter Tangle), were often eaten in Scotland; and even now, though rarely, the old cry, 'buy dulse and tangle,' may be heard in the streets of Edinburgh. When stripped of the thick part, the beautiful *Alaria esculenta* forms a part of the simple fare of the poorer classes of Ireland, Scotland, Iceland, Denmark, and the Faroe Islands.

"To go further from home, we find the large *Laminaria potatorum* of Australia furnishing the aborigines with a portion of their 'instruments, vessels, and food.' On the authority of Bory de St. Vincent, the *Darvillea utilis* and other *Laminariæ* constitute an equally important resource to the poor on the west coast of South America. In Asia, several species of *Gelidium* are made use of to render more palatable the hot and biting condiments of the east. Some undetermined species

of this genus also furnished the materials of which the edible swallows' nests are composed. It is remarked by Lamouroux, that three species of swallow construct edible nests, two of which build at a distance from the sea-coast, and use the sea-weed only as a cement for other matters. The nests of the third are consequently most esteemed, and sold for nearly their weight in gold. *Gracillaria lichenoides* is highly valued for food in Ceylon and other parts of the east, and bears a great resemblance to *Gracillaria compressa*, a species recently discovered on the British shores, and which seems to be little inferior to it; for my friend Mrs. Griffiths tried it as a pickle and preserve, and in both ways found it excellent.

"It is not to mankind alone that marine Alge have furnished luxuries, or resources in times of scarcity. Several species are greedily sought after by cattle, especially in the north of Europe. *Rhodomenia palmata* is so great a favorite with sheep and goats, that Bishop Gunner named it *Fucus ovinus*. In some of the Scottish islands, horses, cattle, and sheep, feed chiefly upon *Fucus vesiculosus* during the winter months; and in Gothland it is commonly given to pigs. *Fucus serratus* also, and *Chorda Filum*, constitute a part of the fodder upon which the cattle are supported in Norway.

"In medicine we are not altogether indebted to the Alge. The *Gigartina helminthocorton*, or Corsican Moss, as it is frequently called, is a native of the Mediterranean, and held once a considerable reputation as a vermifuge. The most important medical use, however (omitting minor ones), derived from sea-weeds, is through the medium of Iodine, which may be obtained either from the plants themselves, or from kelp. French kelp, according to Sir Humphrey Davy, yields more Iodine than British; and, from some recent experiments made at the Cape of Good Hope by M. Ecklon, *Laminaria buccinalis* is found to contain more than any European Alge. Iodine is known to be a powerful remedy in cases of goitre. The burnt sponge formerly administered in similar cases, probably owed its efficacy to the Iodine it contained; and it is also a very curious fact, that the stems of a sea-weed are sold in the shops, and chewed by the inhabitants in South America, wherever goitre is prevalent, for the same purpose. This remedy is termed by them *Palo Coto* (literally, goitre-stick); and from the fragments placed in my hands by my friend Dr. Gillies, to whom I am indebted for this information, the plant certainly belongs to the order *Laminariæ*, and is probably a species of *Laminaria*.

"Were the Alge neither 'really serviceable either in supplying the wants or in administering to the comforts of mankind' in any other respect, their character would be redeemed by their usefulness in the arts; and it is highly probable that we shall find ourselves eventually infinitely more indebted to them. One species (and I regret to say that it is not a British one) is invaluable as a glue and varnish to the Chinese. This is the *Gracillaria tenax*, the *Fucus tenax* of Turner's *Historia Fucorum*. Though a small plant, the quantity annually imported at Canton from the provinces of Fokien and Tchekiang is stated by Mr. Turner to be about 27,000 lbs. It is sold at Canton for 6d. or 8d. per pound, and is used for the purposes to which we apply glue and gum-arabic. The Chinese employ it chiefly in the manufacture of lanterns, to strengthen or varnish the paper, and sometimes to thicken or give a gloss to silks or gauze. In addition to the above account, the substance of

which I have extracted from Mr. Turner's work. Mr. Neill remarks that it 'seems probable that this is the principal ingredient in the celebrated gummy matter called Chig-chon, or Hai-tsai, in China and Japan. Windows made merely of slips of bamboo, crossed diagonally, have frequently their losenge-shaped interstices wholly filled with the transparent gluten of the Hai-tsai.'

"On the southern and western coast of Ireland, our own *Chondrus crispus* is converted into size, for the use of house-painters, &c.; and, if I be not erroneously informed, is also considered as a culinary article, and enters into the composition of blanc-mange, as well as other dishes. In the manufacture of kelp, however, for the use of the glass-maker and soap-boiler, it is that the Algae take their place among the most useful vegetables. The species most valued for this purpose are, *Fucus vesiculosus*, *nodosus*, and *serratus*, *Laminaria digitata* and *bulbosa*, *Himanthalia lorea*, and *Chorda Filum*." There are about 400 Algae, natives of Britain, some of them of fresh, others of salt water production.

CLEANING PICTURES.

THE reason that oil paintings have become dim, dark and discolored, is in consequence of the effect of light upon the varnish with which they are covered at the finishing of the painting; the removal of this therefore restores the painting to its original tints, and a fresh coat of varnish will restore it to the first beauty and freshness. Many things have been recommended for the purpose of cleaning pictures, but they are mostly unsafe; the following simple processes alone can be relied upon without danger of injury to the painting, though much depends upon the nature of the varnish which was employed originally; if copal varnish, it is very difficult to remove; if mastic varnish, there is little difficulty.

The common method of removing the varnish is by rubbing the surface with the ends of the fingers, previously dipped in some resinous powder. By continuing this rubbing for some time, the varnish will give way, and may soon be completely removed. To prevent the epidermis of the fingers from being carried off by this process, fine fish skin is much employed. In either case the dust ought to be frequently wiped off, to ascertain that the picture is not receiving any damage.

The other way of removing the varnish is by applying a mixture of alcohol, spirit of turpentine and oil, in the following manner; take a little bag of cotton in each hand; one of these is to be dipped in the above mixture, the other in pure oil. The operation is to be commenced by rubbing with oil the part to be deprived of its varnish; the spirituous mixture is then applied, and the varnish dissolves rapidly: for this reason the rubbing must be continued only for a few seconds, and then the action should be stopped by the application of the oil. Without this precaution, there would be a danger of disturbing a part of the color; and the bag holding the dissolving liquid should also be looked at every moment, to observe whether it has attacked more than the varnish; and as the power of dissolving the varnish depends upon the quantity of alcohol employed, it would be better to use too little of it at first, rather than, by making it strong, endanger the painting.

UTILITY OF IVY.

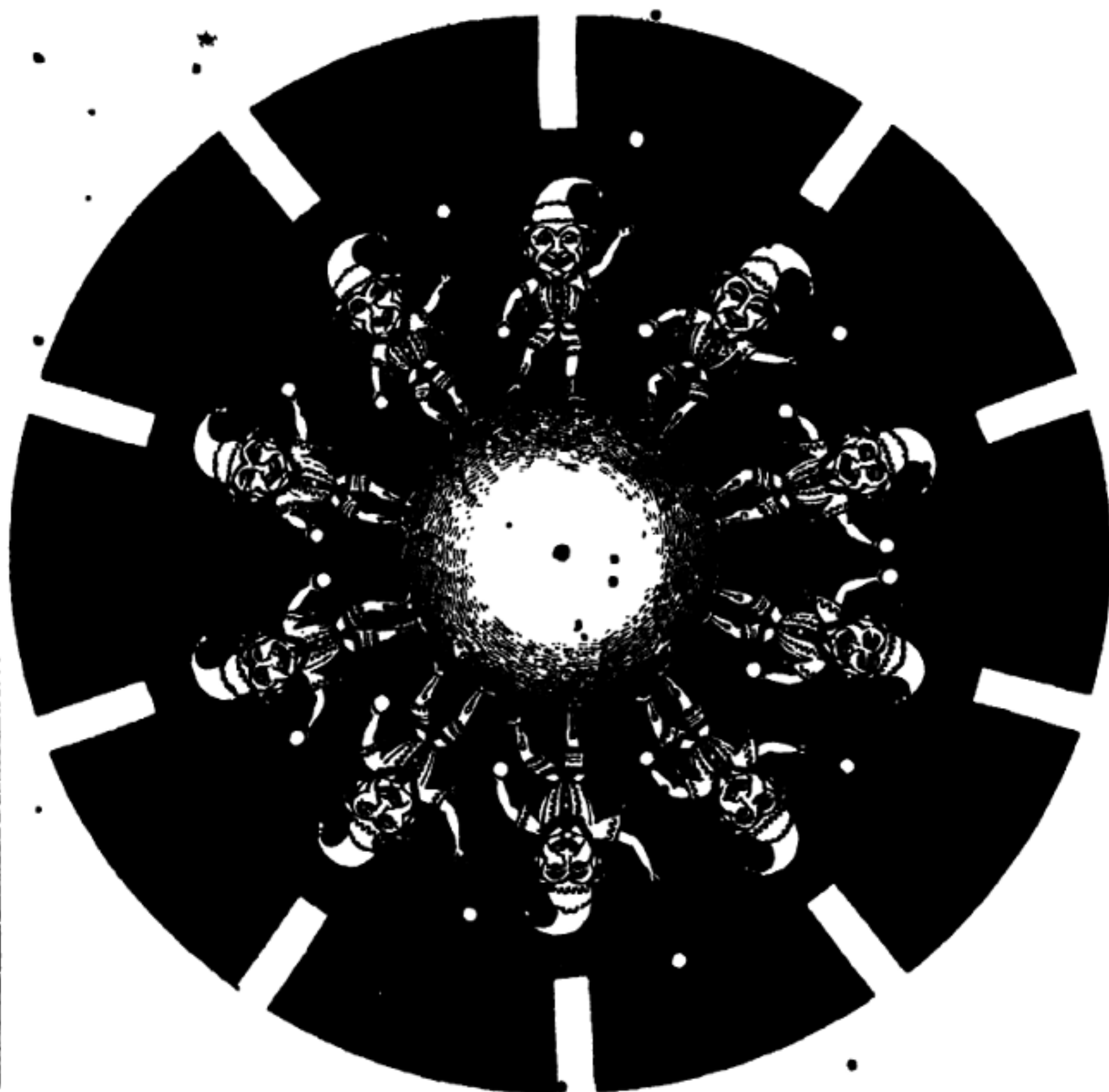
A CLERGYMAN of Low Furness thus writes to the Editor of the *Westmoreland Gazette*:—"A good many years ago I inhabited a parsonage-house, built of bricks, near Manchester, which was perpetually damp from the inroads of the weather, insomuch that the paper of my rooms was completely disfigured. At a considerable expense I had the house well pointed, that is, the interstices betwixt the bricks outside filled up in the best possible manner, but still without any beneficial result. At the last I resorted to ivy, which, being of the Irish kind, grew rapidly; and in an incredible short space of time I had the satisfaction to observe a manifest improvement; and, when the plant had progressed sufficiently high to cover the surface of the exposed side of the house, it became a cure, the interior having become quite dry, and the rooms having been papered anew, were never subject to damp afterwards. I am aware that many ascribe damp to the trees attached to them; and I believe this to be correct with regard to fruit-trees, inasmuch as the water is apt to follow the nails which necessarily perforate the wall; but this is not the case with ivy, as it seldom requires nails to render it adhesive, being sufficiently tenacious in its own nature. After the most stormy nights, I have frequently examined the outer walls under the ivy, and have found them not only dry, but dusty. From the above experiment I should be inclined, in all cases of damp, to resort to ivy in preference to slates, cement, or any other substitute."

MEMORANDA.

New method of making Type.—A patent is about to be taken out for producing printing-types on a new principle, without the necessity of casting. The amalgam of the metal will be different to that now used, being harder, consequently more lasting, and better adapted for machine-printing. The cost, it is expected, will be rather lower than at present; but the principal economy will be in its durability. With the aid of the electrotyping process, some ingenious practical men in London are realizing money by supplying small founts, and what are technically termed lines, sorts, and fac-similes, at very reduced prices.

Derbyshire Diamonds.—Perhaps it may not be generally known that the Peak of Derbyshire produces what are termed Derbyshire diamonds; they are small detached and perfect crystals of colorless quartz, of an hexagonal prism terminated pyramids, and others of a lighter color; they are often found at Bakewell, Brassington Common, Buxton, Castleton, and Darley Dale, and are greatly inquired after, and much used by the lapidaries of Birmingham, Derby, &c.

A new Varnish.—A Hampshire paper mentions that, at the suggestion of Mr. Thomas Grant, of the Royal Clarence Victualling Yard, a new varnish, manufactured of naphtha, is in future to be substituted for the paint now applied to the outside of the iron water-tanks of Her Majesty's ships, the cost of which is only one-fourth that of paint. The varnish has been well tested, and proved to be perfectly efficacious, and is applicable to all sorts of wood and metal.



THE PHANEKISTOSCOPE.

We have often been requested to give a philosophical account of the phanekistoscope, a small instrument or toy, so painted with figures, that being set in motion, in a particular manner, it shall represent a single object, and that one in motion.

Suppose we have a card or thin board, painted with figures, as in the cut, around a circle, and with the arms and legs of the figures in different positions, as represented; the ground of the picture being either black or white as our fancy dictates. Next suppose that this card had as many pieces cut

out of its edge as there are figures, and also that it be supported by a pin thrust through the centre. If we turn the face of the picture to a looking glass, and place our eye close behind it at one of the holes, upon twirling the picture round, and keeping our eye steadily looking through the hole at the looking glass, the picture will still remain visible to us, although as must be evident the card itself intercepts the view during the greatest portion of the revolution. If all the figures were alike we should see one apparently immovable before us, but if the

arms of the figure be varied in position, as afterwards described, the arms will appear in motion; or in the illustration we have chosen, the figure will appear alternately throwing up and catching a ball, first with one hand and then with the other. We will first describe the method of drawing the figures, and afterwards the mode of their action. First, suppose the cut we have given to be numbered in the same manner as the figures on the dial of a clock; as there are ten figures, then that at the top will be No. 10. The one next to this on the right hand will therefore be No. 1, the second No. 2, and so on all the way round. Now consider the figure at the top or No. 10; a ball is in the air over his right hand, another ball is held in his left hand, while the left foot is elevated. In figure No. 1 the ball is only half as high in the air as before, his right hand is less elevated, his left hand more elevated, and his left foot less so; in fact three of his limbs and the ball have altered their position. Now look at No. 2; the figure has just caught the one ball, and is about to throw the other; his feet are nearly at rest. In figure 3 the right foot begins to be elevated, while the ball has descended, and the other is elevated to the height of his arm. In figure 4 the ball has flown, and the foot been raised. In figure 5 the ball and contrary foot have reached their highest elevation, or it brings us to a similar position as that we started from, except that the ball is to be caught by a different hand. During the other half of the circle the same changes take place, but in contrary order, until we merge at last into the original figure, No. 10. All designs for the phanekistoscope must be constructed upon the same principle, whether it be the throwing of balls, a dancing figure, a gaping mouth, boys playing at leap frog, swinging, sea-saw, or any other alternate motion, as will be evident by the following explanation:—An object once impressed upon the retina remains there an eighth part of a second, notwithstanding the interposition of an opaque body; thus it is in twirling round the end of a lighted stick, a circle of fire is visible, and owing to the same fact it is that the natural operation of momentarily closing and opening the eye, which occurs with us so constantly, is imperceptible, and does not diminish the vividness of our sight, in consequence of the eye-lid not remaining over the eye-ball so long as the eighth of a second of time. When we hold the apparatus before a looking glass, and look through one of the holes, we see the whole declination before us, and naturally fix our attention to the upper figure, which will be the one under the hole we look through; we see the figure therefore as No. 10. This figure remains vividly depicted on the retina during the passage of the dark part of the card over the eye-ball, but when the hole No. 1 comes before our eye we catch a second glimpse of the figure; but as this was drawn differently, it is only the parts which exactly resemble the same parts of the first figure which renew the same impression as before; the arms and ball being different, they will appear to have changed their place. The third, fourth, and all the other figures act in the same way; the heads, caps, and bodies being the same will appear immovable, but the arms and leg will appear in motion from the cause above stated, and as the various figures are so modelled as to return to the original one at last, the whole appears like a grotesque figure throwing up balls and dancing at the same time. The designs should be about double the size of that we have represented, and if colored will have a much more striking effect.

ON LATENT LIGHT.

BY PROFESSOR MOSER.

(Abridged from *Poggendorff's Annalen*.)

(Resumed from page 772.)

We are accustomed to say that blue and violet glasses, which allow but few rays of light to pass through them, act powerfully on iodide of silver, while yellow and red glasses, which allow the transition of a large quantity of light, act only feebly; but I do not think that in the present state of the science we may be allowed such an expression; by using it we should be placing more reliance on the judgment of the eye than it in reality deserves. We are well aware that our retina is affected most strongly by yellow and orange; so that if by its means we seek to judge of prismatic spectra, these colors are always considered as the brightest. If the retina were a substance like iodide of silver, or if it were freely exposed to the rays of light, the decision would certainly be different; under the same circumstances, the violet, or Ritter's dark rays, would appear to it the brightest, those rays which in its actual state produce little or no effect on it would then exert the strongest action. It is just the same with the retina and the different compounds of silver as with the other bodies which have as yet been exposed to the action of light; it has always been found that the rays of a particular period of oscillation are the most energetic in their action. This appears to me to prove both that these bodies and the retina are by no means adapted to the determination of the relative intensities of the different colored lights, and that therefore no very great degree of faith can be reposed upon the decision of the latter, viz. that a violet glass transmits few, and a yellow many rays. Apart from this, we find that rays of different degrees of refrangibility do not agree in regard to the blackening of the iodide of silver; certainly in respect to the time necessary for the operation, but in nothing else. And now we see that this effect is connected with the duration of oscillation; so that we may say, the greater the duration for one group of rays the longer space of time will they need to commence action on the iodide of silver, and to continue it until blackening ensues.

I now return to the peculiar power which red rays are said to have of continuing an action which has been already begun. In my treatise on vision I have raised some doubts with regard to the peculiar action of this class of rays, and I have mentioned the principal argument by which such an idea would be subverted; but among so many others I did not direct more particular attention to the importance of that fact. It is true, that if the operation, as for instance the production of a Daguerre's picture, be performed in the common rays of sun or daylight, then the red rays have a powerful continuing action, for it was in this case commenced by the blue, violet, and Ritter's dark rays. But now I have discovered and described another class of rays of light, those emitted by every body without exception, because it is self-luminous,—rays whose presence is evidenced by the fact of two sufficiently approximated bodies impressing their images on each other, although everything that the retina could denominate light has been excluded. I call them the invisible rays of light, to distinguish them from Ritter's dark rays at the violet end of the spectrum; I might also call them the most

refrangible rays, for it appears that their refrangibility is greater than that of the other rays of the spectrum. As I shall show, they are not present in day and sunlight, and must not therefore be confounded with the above-mentioned dark rays. When the invisible light has commenced its action upon iodide of silver, the blue or violet rays possess the same continuing power as the red rays when the primary effect has been produced by visible light. Place any body on an iodized silver plate, either in absolute contact, or else at a very small distance, so that an image may be produced by the emitted rays. This body must be retained in its position so short a time that there is no outwardly visible image produced, and no visible alteration of the iodide of silver. If the plate be now placed in sun or daylight under a blue or even a violet glass, the picture is rapidly formed with all its details, while the most continuous action of the red and yellow rays does not produce in this case any more than a very slight trace of the image. This I have stated in my former paper, and it shows that the blue rays stand in the same relation to invisible light that the red do with regard to visible light. I will only mention one of the numerous experiments which I made on this point, and which all gave the same result, because I must return to the subject when speaking of the latent color of vapors. I iodized a plate of silver, and laid upon it an engraved brass plate, a similar one of silver, and an engraved stone, for the short space of two minutes, and in the dark. Of course there was nothing at all to be seen on the plate; but when exposed to the sun under blue glasses, the images appeared in a few minutes, and those of the metallic bodies were very perfect; consequently the invisible rays of light had produced perfect pictures in the course of two minutes. If red or yellow glasses had been used, probably no image at all would have been produced by so short an action; for rays of these colors render images of the invisible rays apparent only after a long interval, and then very imperfectly.

I will now turn to the peculiar power which the yellow and green rays are said to possess, of converting the blackened iodide of silver into its primitive colored variety, of which many examples were offered in my first treatise. The most convenient way of making these experiments is to allow a negative picture to be produced in the camera obscura, one in which the bright parts of the object are dark, and then to expose it to the light of day or the sun, covered by a green or yellow glass. A positive image is produced, for the black iodide is decolorized, and the unaffected parts are turned black. Gaudin made his experiments in this manner.

I will now show that this singular property does not appertain to the yellow or green rays alone, but just as well to all the others, and that in this respect there is no difference between the colors except in point of time. A plate, in that state in which it is generally exposed to the mercurial vapors, is exposed to day or sunlight under a red glass; a negative picture is produced. If in its first stages it be placed under a yellow glass, it becomes positive; if under green or blue, it becomes not positive. If, however, the negative image is further advanced, if it has remained longer under the red glass, then the green rays will render it positive, and finally also the blue and violet. This result is so interesting, that I will mention one or two of the experiments performed. An iodized silver plate was allowed to remain in the camera obscura for three minutes, and then placed

under a reddish-yellow glass.* First of all a negative image was produced, which was afterwards transformed into a positive one. Just as the latter was about forming, the plate was put under a violet glass, and it was then very quickly developed. Moreover, on a tolerably clear day, an iodized silver plate was left in the camera obscura eleven hours; a beautiful negative image was visible, the light parts were greenish, and the dark of a reddish color. On placing the glass under a dark blue glass, a strong positive image was formed in the course of half an hour, and this was not changed by exposure for several days.

Bring an iodized silver plate into the camera obscura, and leave it there until the image has arrived at the state which may be generally called "that of Daguerre." No trace of the image is seen on the plate, as is well known, although it is present and may be brought out by means of mercurial vapors. If this plate be now exposed to day or sun-light, strange to say, no image is formed, but the plate is only uniformly blackened. In such a case I should say that the undecomposed light has "levelled" the image, for there was no apparent difference between the affected and unaffected parts. What is still more extraordinary is, that if the plate be allowed to remain still longer in the camera obscura, so that a negative image is formed, it is also washed out by undecomposed light, and only remains fixed when the negative image has reached one of the higher stages of development, and in this case it is destroyed neither by undecomposed light nor by any color whatever, but it remains for some time unchanged, and then passes into a positive image, as has been already described. This destruction of the images by undecomposed light does not depend upon the simultaneous action of the differently colored rays of which it is composed, because blue and violet light, and partly the green, are capable of performing the same thing. The first two will always destroy the image if it is in the Daguerrian state, or even a negative one, if not very strongly formed, and indeed just as well as day or sun-light.

If we consider the above-mentioned fact, keeping in mind the axiom which we have proposed concerning the action of the several colors, we shall arrive at an idea of the phenomenon of *levelling*, which agrees sufficiently well with the reality. When the ordinary rays in a camera obscura have only acted a short time on the iodide of silver, then rays of any degree of refrangibility are capable of levelling the image, which is always supposed to exist, although means have not been employed to render it apparent. If the rays have acted for a longer time, then all of them except the red are able to level the image, and this is because the rays of this color differ sufficiently in refrangibility from those which had commenced the action. If the plate remains still longer in the camera obscura, we may suppose that the effect has been produced by still more refrangible rays than the blue, violet, or dark parts of the spectrum, and now a uniform illumination of the image with yellow light is not capable of destroying or levelling it, &c. Finally, if the plate has remained several hours or even days in the camera obscura, then the blue and violet rays are not capable of levelling the image, as has been shown above. We will now extend the discussion to the invisible rays, which have been proved to possess the greatest degree of refrangibility. In this case also they justify the character which has been given to them, and consequently the process

of levelling furnishes us with a means of determining the relative refrangibility in cases where the methods employed with the ordinary rays are of no avail whatever. As the most refrangible rays are capable of levelling the image while it is in the Daguerrian state, the invisible rays will also be able to effect it. In order to prove this I allowed several iodized plates to remain so long in the camera obscura that they would have produced the images with great accuracy if afterwards treated with mercurial vapors. I then placed these plates on pure silver, gold, copper, mirror-metal, iodized silver, and porcelain, either in such a manner that a contact (although only partial) took place, or else so that they could not touch each other on account of the interposition of strips of mica. When the plates had lain a considerable time in the dark the images were for the most part completely levelled; in some cases a trace of them was made visible by the mercurial vapors, but even then only on certain parts of the plate. The invisible rays had in this case levelled the images produced by the visible rays; they are capable of doing the same with images produced by their own means, if they are still in their earlier stages of development. Bodies of silver, gold, iron, and horn were laid upon an iodized plate of silver and kept there for an hour, so that their images were formed. However, after a plate of silver and iron had lain upon them for several hours, the images were completely levelled and could not be rendered visible by any means; but if the image produced by the invisible rays is in a more advanced state, then it cannot be destroyed by others of the same kind, of which fact I have convinced myself by a number of experiments. The visible rays, on the other hand, are in no case capable of levelling an image produced by invisible light, and by this it is evident that the latter consists of rays more refrangible than those of the ordinary prismatic spectrum. It would be useless to adduce proofs of this statement, because I am indebted for the knowledge of the identity in the action of light on all bodies, and the extension of Daguerre's discovery to all vapors, to the circumstance that visible rays are not capable of destroying images produced by those which are invisible.

(To be continued.)

COINAGE.

COINAGE is the art of converting pieces of metal into current coins, for the purposes of commerce. The metals to be coined having been first melted, are reduced into plates of the requisite thickness, by being passed, repeatedly between the steel cylinders of laminating and drawing machines. These thin plates are then subjected to the action of a cutting out press, by means of which they are divided into circular pieces, nearly of the size of the intended coin, in which state they are called blanks. These are then carried to the sizing room, where each individual piece is adjusted to its standard weight. The pieces which are too light, are selected to be again melted; and those which are too heavy, are subjected to the action of a rasp or file. The pieces thus adjusted, being in a state of great hardness, from compression by the rolling and drawing processes, by which all their latent heat had been squeezed out, are again subjected to the action of a clear red heat in a reverberatory furnace, after which they are boiled in very weak sulphuric acid, which makes them perfectly clean. After having been dried either in

warm saw dust, or over a slow fire, they are in a state for the two succeeding processes of milling and stamping. The operation of milling is performed round the edge to prevent their being clipped or filed. The principal pieces of this machine, are two thin steel plates, about a line or the eighth of an inch thick, one-half of the milling or legend, or of the ring, is engraved on the thickness of one of these lamina, and the other half on the other, and these two plates are straight, although the blank or coin to be marked by them is circular. The blanks (or planchets as they are also called) are put in between these laminæ in such a manner, as that each of them being laid flat upon a copper plate, which is fastened upon a very thick wooden table, and the planchet being likewise laid flat upon the same plate, the edge of the planchet may touch the two laminæ on each side, and in their thick part. One of these laminæ being immovable, and fastened by means of several screws, the other is made to slide by means of an indented wheel, which is made to receive the teeth that are upon the surface of the steel lamina. This sliding plate makes the circular piece of metal turn round in such a manner, that it remains stamped on the edge, when it has made one turn. Only crown, and half-crown pieces can bear the impression of letters on the thickness of their edges.

The coining engine, or mill, is so constructed, that one workman may stamp 20,000 coins in a single day. Gold, silver, and copper planchets, are all of them coined in a mill, into which the coining squares, or dies as they are called, are fastened. That of the face underneath in a square box, garnished with male and female screws, to fix and keep it steady; and the other above, in a little box furnished with similar screws to fasten the coining square. The planchet is laid flat on the square of the effigy, which is dormant, and the bar of the mill being immediately pulled by its cords, causes the screws set within it to turn. This enters into the female screw, which is in the body of the mill, and turns it with so much force, that by depressing the upper square upon that of the effigy, the planchet lying between both, being suddenly and violently compressed, receives both the impressions in the twinkling of an eye.

The mode of manufacturing the dies is very curious. An original design is engraven upon a piece of soft cast steel of the size of the money to be coined. The table of the die must be perfectly level or square. The impression is cut into the steel, and its depth is in proportion to the relief, ultimately required upon the face of the coin. When the engraving is finished, the die is then hardened. This is a very nice process, and requires considerable care to perform it. The die is put into a cast iron pot, completely embedded in animal charcoal, chiefly made from leather. The pot is placed in an air furnace, in which coke or charcoal is burned, which gives a steady and uniform degree of heat. The die having endured its proper degree of heat is withdrawn from the furnace, and plunged into a large cistern of cold water, into which a stream is constantly kept flowing. If the steel, as sometimes happens, is faulty, or heated to excess, it will fly to pieces, and all the artist's labors be lost. If perfect, however, it is now placed in the multiplying die-press. An impression is thus taken from the hardened die upon a blank die of cast steel, similar to the mode of impressing the money. The blank die is fixed to the lower die of the coining press, and by working the screw of the press, which has very long and heavily loaded arms, the matrix is made to strike the blank die with great force, and bring its

impression in raised relief upon its surface. The hardness following this violent compression of the steel is so great, that a proper impression of the matrix cannot be procured without annealing and softening the die perhaps two or three times, which is done in iron pots, as in the case of hardening, but without cooling them so hastily. An impression taken this way is called a puncheon die. When the die sinker has given all the more delicate lines of the original to it, it is then hardened in the same manner as its original, and in its turn employed to give impressions to blank dies by a similar process, the impression being sunk into the dies, which again being used for coinage, give the impression in raised relief to the money. This department of the mint is under the superintendence of the clerk of the irons, who never suffers the multiplying press to be used but in his presence. He has also the care of all the dies, and must account to the Board of Management for all matrices, puncheons, and dies made and destroyed in the mint.

GLUES.

Isinglass glue is made by dissolving beaten isinglass in water by boiling, and having strained it through a coarse linen cloth, evaporating it again to such a consistence, that, being cold, the glue will be perfectly hard and dry. A great improvement is said to be made in this glue by adding spirits of wine or brandy to it, after it is strained, and then renewing the evaporation till it gains the due consistence. Some soak the isinglass in the spirit or brandy for some time before it is dissolved, in order to make the glue, and add no water, but let the spirit supply the place of it.

Parchment glue.—Take one pound of parchment and boil it in six quarts of water till the quantity be reduced to one quart; then pour off the fluid from the drugs, and boil it again, till it be of the consistence of glue.

Lip glue, for cementing paper, silk, and thin leather.—Take of isinglass glue and parchment glue, each one ounce; of sugar-candy and gum-tragacanth, each two drams. Add to them an ounce of water, and boil the whole together till the mixture appears, when cold, of the proper consistence of glue. Then form it into small rolls, or any other convenient figure. This glue being made wet with the tongue, and rubbed on the edges of the paper, &c., will, on their being laid together and suffered to dry, unite them as firmly as any other part of the substance.

A very strong compound glue.—Take common glue in very small or thin bits, and isinglass glue, and infuse them in as much spirit of wine as will cover them, for at least twenty-four hours. Then melt the whole together, and, while they are over the fire, add as much powdered chalk as will render them an opaque white.

A glue which will resist moisture.—Melt common glue with water to a proper consistence; add one-eighth of boiled linseed oil, dropping it into the glue gently, and stirring it all the time. This glue may be rendered stronger by the addition of some powdered chalk.

A good glue may be made for the same purpose, by adding half a pound of common glue or isinglass glue to two quarts of skimmed milk, and then evaporating the mixture to the consistence of the glue.

A very strong glue that will resist moisture.—Dissolve gum-sandarac and mastic, of each two

ounces, in a pint of spirits of wine, adding about an ounce of clear turpentine. Then take equal parts of isinglass and parchment glue, made according to the directions in the preceding articles, and having beaten the isinglass into small bits, as for common uses, and reduced the glue to the same state, pour the solution of the gums upon them, and melt the whole in a vessel well covered, avoiding so great a heat as that of boiling water. When melted, strain the glue through a coarse linen cloth, and then, putting it again over the fire, add about an ounce of powdered glass.

A strong glue suitable for veneering or inlaying.—Dissolve the best glue in water, and to every quart add a gill of the best vinegar, and an ounce of isinglass.

A glue suitable for inlaying brass, silver, &c.—Melt the best glue in the usual way; add four spoonfuls of rosin and the like quantity of brick-dust, (both finely powdered) to every quart of the dissolved; incorporate the whole well together, and it will be found to hold the metal much firmer than the glue by itself. The best glue may be easily known by its transparency, and being of rather a bright brown color, and free from clouds, streaks, &c.

Hints on making and using glue.—The hotter glue is, the more force it will exert in keeping the two parts glued together; therefore, in all large and long joints, the glue should be applied immediately after boiling. Glue loses much of its strength by being often melted; that glue, therefore, which is newly made, is much preferable to that which has been used.

CLIMATE.

THE ancients denoted by this name the spaces between the imaginary circles, parallel to the equator, drawn in such a manner over the surface of the earth, that the longest day in each circle is half an hour longer than in the preceding. According to this division, there were twenty-four climates from the equator, where the longest day is twelve hours, to the polar circle where it is twenty-four hours. From the polar circle, the longest day increases so rapidly, that, only one degree nearer the pole, it is a month long. The frigid zones, so called, that is, the regions extending from the northern and southern polar circles to the corresponding poles, some geographers have divided again into six climates. We have learned from a more accurate acquaintance with different countries, that heat or cold depends not merely on geographical latitude, but that local causes also produce great variations from the general rule, by which a region lying near the equator should always be warmer than one remote from it. By the word climate, therefore, we understand the character of the weather peculiar to every country, as respects heat and cold, humidity and dryness, fertility, and the alteration of the seasons. The nature of a climate is different according to the different causes which affect it, and the observations hitherto made have led, as yet, to no definite result. In general, however, geographical latitude is the principal circumstance to be taken into view in considering the climate of a country. The highest degree of heat is found under the equator, and the lowest, or the greatest degree of cold, under the poles. The temperature of the intermediate regions is various, according to their position and local circumstances. Under the line, the heat is not uniform. In the sandy deserts of Africa, particularly

on the western coast, also in Arabia and India, it is excessive. In the mountainous regions of South America, on the contrary, it is very moderate. The greatest heat in Africa is estimated at 70° of Réaumur, or $189\frac{1}{2}^{\circ}$ of Fahrenheit. The greatest degree of cold at the poles cannot be determined, because no one has ever penetrated to them. The greatest altitude of the sun at noon, and the time of its continuance above the horizon, depends altogether on the latitude. Without regard to local circumstances, a country is warmer in proportion as the sun's altitude is greater and the day longer. The elevation of any region above the surface of the sea has likewise an important influence on the climate. But the nature of the surface is not to be disregarded. The heat increases as the soil becomes cultivated. Thus, for the last thousand years, Germany has been growing gradually warmer by the destruction of forests, the draining of lakes, and the drying of bogs and marshes. A similar consequence of cultivation seems to be apparent in the cultivated parts of North America, particularly in the Atlantic states. The mass of minerals, which composes the highest layer of a country, has, without doubt, an influence on its temperature. Barren sands admit of a much more intense heat than loam. Meadow lands are not so warm in summer as the bare ground. The winds, to which a country is most exposed by its situations, have a great influence on the climate. If north and east winds blow frequently in any region, it will be colder, the latitude being the same, than another, which is often swept by milder breezes from the south and west. The influence of the wind on the temperature of a country is very apparent in regions on the sea-coast. The difference in the extremes of temperature is least within the tropics. The heat, which would be intolerable when the sun is in the zenith, is mitigated by the rainy season which then commences. When the sun returns to the opposite half of the torrid zone, so that its rays become less vertical, the weather is delightful. Lima and Quito, in Peru, have the finest climate of any part of the earth. The variations in temperature are greater in the temperate zones, and increase as you approach the polar circles. The heat of the higher latitudes, especially about 59° and 60° amounts, in July, to 75° or 80° of Fahrenheit, and is greater than that of countries 10° nearer the equator. In Greenland, the heat in summer is so great that it melts the pitch on the vessels. At Tornea, in Lapland, where the sun's rays fall as obliquely at the summer solstice as they do in Germany at the equinox, the heat is sometimes equal to that of the torrid zone, because the sun is almost always above the horizon. Under the poles, the climate is, perhaps, the most uniform. A greater degree of cold than any we are accustomed to seems to reign there perpetually. Even in midsummer, when the sun does not go down for a long time (at the poles not for six months), the ice never thaws. The immense masses of it, which surround the poles, feel no sensible effect from the oblique and feeble beams of the sun, and seem to increase in magnitude every year. This is very remarkable; for there is the most undoubted evidence that these now deserted countries were, in former ages, inhabited. But, within a few years, large portions of this continent (if we may so call it) of ice have separated, and floated down to southern seas. This led the British government to adopt the project of penetrating to the north pole.

From the general division of America into lofty

mountainous plateaus and very low plains, there results a contrast between two climates, which, although of an extremely different nature, are in almost immediate proximity. Peru, the valley of Quito, and the City of Mexico, though situated between the tropics, owe to their elevation the general temperature of spring. They behold the paramos, or mountain ridges, covered with snow, which continues upon some of the summits almost the whole year, while, at the distance of a few leagues, an intense and often sickly degree of heat suffocates the inhabitants of the ports of Vera Cruz and of Guayaquil. These two climates produce each a different system of vegetation. The Flora of the torrid zone forms a border to the fields and groves of Europe. Such a remarkable proximity as this cannot fail of frequently occasioning sudden changes, by the displacement of these two masses of air, so differently constituted—a general inconvenience, experienced over the whole of America. Everywhere, however, this continent is subject to a lower degree of heat than the same latitudes in the eastern portion of the earth. Its elevation alone explains this fact, as far as regards the mountainous region; but why, it may be asked, is the same thing true of the low tracts of the country? To this the great observer, Alexander Humboldt, in his *Tableaux de la Nature*, makes the following reply: "The comparative narrowness of this continent; its elongation towards the icy poles; the ocean, whose unbroken surface is swept by the trade winds; the currents of extremely cold water which flow from the straits of Magellan to Peru; the numerous chains of mountains, abounding in the sources of rivers, and whose summits, covered with snow, rise far above the region of the clouds; the great number of immense rivers, that, after innumerable curves, always tend to the most distant shores; deserts, but not of sand, and consequently less susceptible of being impregnated with heat; impenetrable forests, that spread over the plains of the equator, abounding in rivers, and which, in those parts of the country that are the farthest distant from mountains and from the ocean, give rise to enormous masses of water, which are either attracted by them, or are formed during the act of vegetation, all these causes produce, in the lower parts of America, a climate which, from its coolness and humidity, is singularly contrasted with that of Africa. To these causes alone must we ascribe that abundant vegetation, so vigorous and so rich in juices, and that thick and umbrageous foliage, which constitute the characteristic features of the new continent." To these remarks Malte-Brun adds: "Assuming this explanation as sufficient for South America and Mexico, we shall add, with regard to North America, that it scarcely extends any distance into the torrid zone, but, on the contrary, stretches in all probability very far into the frigid zone, and, unless the revived hope of a north-west passage be confirmed, may, perhaps, reach and surround the pole itself. Accordingly, the column of frozen air attached to this continent is no where counterbalanced by a column of equatorial air. From this results an extension of the polar climate to the very confines of the tropics; hence winter and summer struggle for the ascendancy, and the seasons change with astonishing rapidity. From all this, however, New Albion and New California are happily exempt; for, being placed beyond the reach of freezing winds, they enjoy a temperature analogous to their latitude."

REVIEW.

Holtzapffel on Turning and Mechanical Manipulation; intended as a Work of General Reference and Practical Instruction on the Lathe, and the various Mechanical Pursuits followed by Amateurs. Holtzapffel & Co., Charing Cross.

THE first volume of this long-promised, and by us ardently-desired book has made its appearance; and although 15s. appears a somewhat high price for a single volume, out of five on the subject of Turning, yet such an impression is immediately removed upon examination of the book itself, illustrated as it is with 300 wood cuts. It is a reproach to our country that its really practical mechanical books are so few, while its machinery is so excellent and abundant. We have learned treatises enough and to spare upon mechanics, optics, the steam engine, &c.; but upon the making of machinery, of optical instruments and musical instruments, positively nothing, or nothing worth having. A practical work then, like the present of Mr. Holtzapffel's, is refreshing, after the rapid and tedious books which have emanated from the press, professing to give an account of mechanics and similar subjects; of the working details of which the learned writers, generally speaking, know no more than a working man does of a mathematical formula. Let us not be misunderstood; we admit the importance of scientific researches, and would not be thought to undervalue that importance, nor to neglect the theoretic books we have alluded to; but we do desire to see their theories reduced to practice, and thus made applicable to our wants; and although we have no right to blame an author for not attempting to write beyond his knowledge, and admit that he is entitled to insert in his own book what he pleases, yet we are not singular in regretting that works are not written by men of experience as well as learning, that the combination of the two may render the subject complete. These remarks are drawn from us by the nature of Mr. Holtzapffel's book, which is strictly what its title professes, and which is written upon subjects never before so clearly explained, and never so comprehensively treated. This excellent work is to the mechanical world what Faraday's *Chemical Manipulation* is to the chemical, a plain detail of common mechanical processes and manufacturing materials, or as the writer expresses it:—"The volume contains, under three divisions, the description of materials from the vegetable, animal, and mineral kingdoms; their uses in the mechanical arts, dependent on their structural differences and physical characters. The modes of severally preparing, working and joining the materials, with the practical description of a variety of processes, which do not, generally, require the use of tools with cutting edges." We have given in a former number a short extract on two from Mr. Holtzapffel's book, and shall conclude this notice with one upon a different part of the subject, namely

WORKING WITH THE DIAMOND.

"The diamond is the hardest substance in nature, and in common with some other crystalline bodies, it is harder at the natural angles and edges, and also at the natural coat or skin than within, or in its general substance. Its peculiar hardness is probably altogether due to its highly crystalline form, as by analysis the diamond, charcoal, and plumbago, are found to be nearly identical; the first is absolutely pure carbon, the others are nearly so.

"The principal use of the diamond is for jewellery; but from its peculiar hardness the diamond fulfils some more really important, although less brilliant services as tools, without which several curious and highly-valuable processes must be altogether abandoned, and others accomplished in an inferior although more costly manner by other means. The diamond is prepared for the purposes of jewellery by three distinct processes, namely, splitting, cutting and polishing. In order to split off the portions not required, the stone is fixed in a ball of cement, about as large as a walnut, the line of division is sawn a little way with a pointed diamond fixed in another ball of cement, and the stone is afterwards split with the blunted edge of a razor struck with a hammer; the small fragments removed, when they are too small for jewellery, are called *Diamond bort*.

"In cutting, two stones are operated upon at once; they are cemented in the ends of two sticks, which are supported on the edges of a box three or four inches wide, rested against two pins as fulcra, and forcibly rubbed against each other; by which means they abrade each other in nearly flat planes, and remove a fine dust, called *diamond powder*, which falls through the fine holes in the bottom of the box, and is there collected. The diamonds are lastly polished upon an iron lap or *skive*, charged with diamond powder, the stone being guided mechanically; it is fixed by soft solder in a copper cup, or *dop*, attached by a stout copper wire to the end of the pincers, a flat board terminating at the other extremity in two feet, which rest upon a fixed support; the whole forming a long and very shallow triangular stool, loaded at the end near the stone. In the last two processes the stone is re-adjusted for producing each separate facet. We will now proceed to the applications of the diamond as tools.

"The invaluable instrument, the glazier's diamond, although employed for a considerable period, was for the first time investigated scientifically by Dr. Wollaston in 1816, who pronounced its operation to depend upon a peculiarity of crystallization in the diamond, the facets of which are frequently round instead of flat, and therefore the edges are circular instead of straight. The rounded edge first indents the glass, and then slightly separates its particles, forming a shallow fissure, with a splitting rather than a cutting action, none of the material being removed.

"The diamonds for tools are mostly fixed in brass wires, by first drilling a shallow hole for the insertion of the stone, which is embedded slightly below its largest part, and the metal is pinched around it. Shell-lac is also used for cementing them in, and spelter or tin solders may be fused around them with the blow-pipe, but pinching them in annealed brass is preferred. When tools larger than those made of crystals or thin splinters are required, diamond powder is applied upon metal plates, &c., of various forms, which serve as vehicles into which the particles are embedded, either by slight blows of the hammer, or by simple pressure. In the construction of the jewelled holes for watches, and in similar works, the rubies, sapphires, &c., although sometimes split, are more commonly slit with a plate of iron 3 or 4 inches diameter, mounted on a lathe, and charged on the edge with diamond powder and oil. When sliced, they are ground parallel one at a time on a flat plate of copper, (generally a penny-piece,) mounted on the lathe, and into the turned face of which small fragments of the diamond have

been hammered; this is called a roughing mill; a similar plate with fine washed diamond powder is used for polishing them.

"They are afterwards cemented with shell-lac, on the end of a small brass chuck, turned cylindrical on their edges, and bevilled for burnishing into the metal rings. They are also turned concave and convex on their respective faces, the turning tool being a fragment or splinter of diamond, fixed in a brass wire. In drilling the rubies they are chucked by their edges, and a splinter of diamond, also mounted in a wire, is used; should the drill be too conical, the back part is turned away with a diamond tool to reduce it to the proper shape, and from the crystalline nature of the stone, some facets or angles always exist to cause the drill to cut. The holes in the rubies are commonly drilled out at two processes, or from each side, and are afterwards polished with a conical steel wire fed with diamond powder. In producing either very small, or deep holes, a fine steel wire is used, with diamond powder applied upon the end of the same, the limit of fineness being the diameter to which the steel wire can be reduced.

"In drilling larger holes in china, &c., triangular fragments of diamond are occasionally fixed in the cleft extremity of a steel wire, either with or without shell-lac. Another common practice of the glass and china menders is to select a tolerably square stone, and mount it in the end of a taper tin tube, which wears away against the side of the hole so as to become very thin, and by the pressure to embrace the stone by the portions intermediate between its angles. For larger holes, metal tubes fed with diamond powder are used; they grind out an annular recess, and remove a solid core; copper and other tools fed with emery or sand may be thus used for glass, marble, and various other substances. The same mode has been adopted for cutting out stone waterpipes from within one another by the aid of steam machinery. The conical diamond used by engravers for the purpose of etching, either by hand, or with the various machines for laying etching grounds, for ruling medals, and other works, are turned to the cone by a fragment of another diamond, the outside skin or an angle being used, but the tool suffers almost as much abrasion as the conical point, from their nearly equal hardness; therefore the process is expensive, although when properly managed entirely successful.

"To conclude the notice of the diamond tools, a splinter suitable for cutting fine lines and divisions upon mathematical instruments, is selected with a fine acute edge, as the natural angle would be too obtuse for the purpose.

"Mr. Ross, the inventor of the ingenious dividing engine, rewarded by the Society of Arts in 1831, informs me that with a diamond point, presented to him by Mr. Turrell, he was enabled to graduate ten circles upon platinum, each degree subdivided into four parts; at the end of which time the diamond, although not apparently the worse, was accidentally broken. A steel point would have suffered in the graduation of one-third of a single circle upon platinum, so as to have called additional pressure with the progress of the work, which in so delicate an operation is of course highly objectionable."

The above article is rendered still clearer by Mr. Holtzapffel, by the introduction of figures, which we have been obliged to omit. We strongly recommend the work itself to all our mechanical friends.

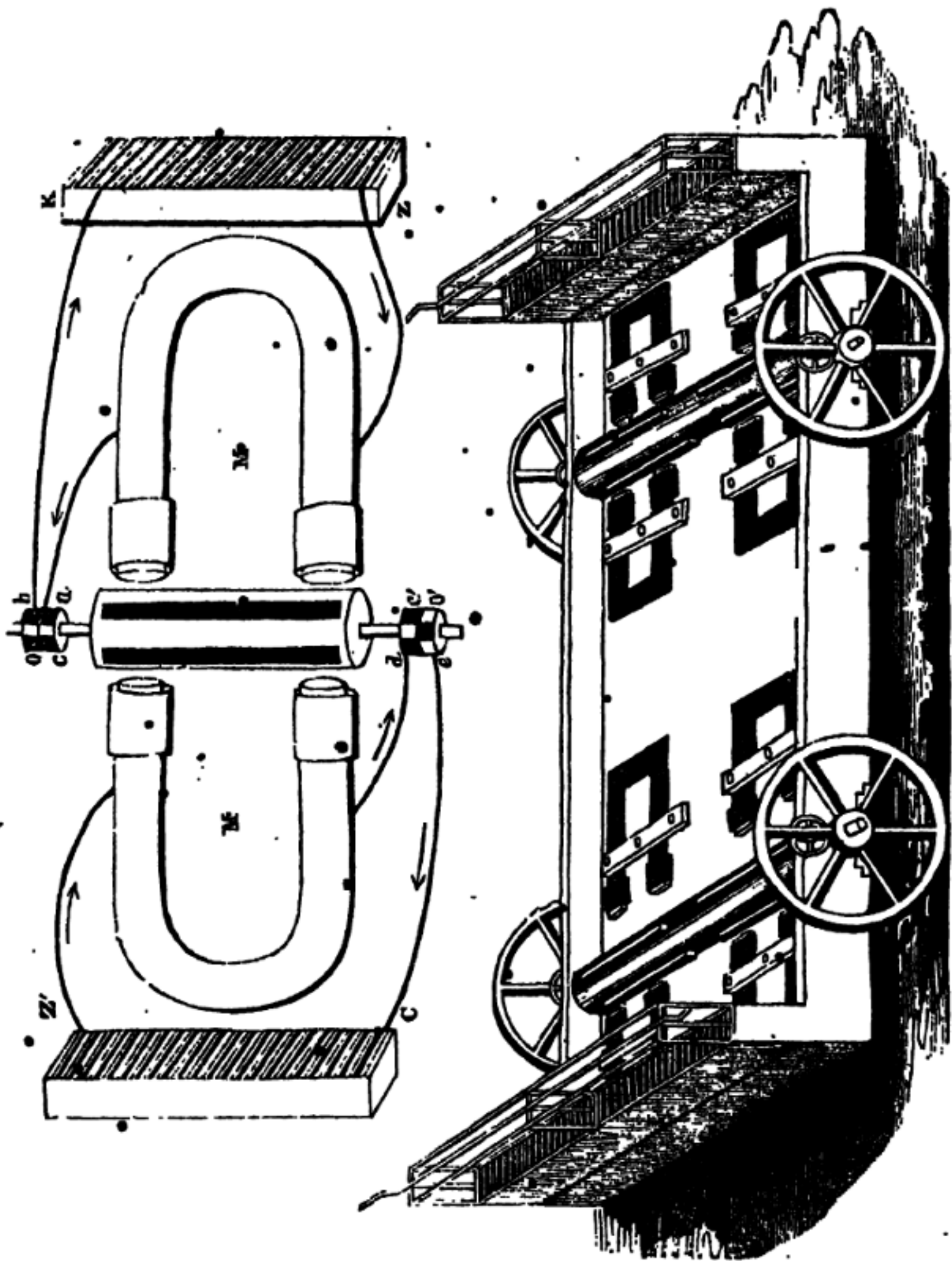
PROTECTION FROM ACCIDENT BY DELETERIOUS GAS.

AN invention is described in the French papers which will, it is said, give such timely notice of the presence of deleterious gas in mines, or other places, as will enable persons to take the necessary precautions to guard against explosions. An explosion from the admixture of carburetted hydrogen with atmospheric air can only take place when the former exists in a certain and known proportion. When the quantity has reached or exceeded this point, the contact of a light instantly causes an explosion. The instrument recently invented has a sort of tell-tale to show the existence of danger; is simple, ingenious, and effectual. Connected with a chemical solution, is a kind of float, nicely graduated, and attached to a counterpoise. The solution is of such a nature that it undergoes a change when acted upon by the admixture of carburetted hydrogen, and when saturated to a certain point the float changes its position, and acting in its turn upon the counterpoise, a spring is let loose, and strikes upon a bell or drum, giving out a loud sound, and thus indicating the presence of danger. This ingenious test is not liable to derangement, and the whole apparatus is comprised within a small compass, and of little cost. The solution can be varied so as to be adapted to every kind of deleterious gas.

EGYPTIAN FLAX.

ABOUT two years ago we were shown samples of Egyptian flax, by one of the most enterprising of our local mill-spinners, who were then of opinion that the attention of manufacturers required only to be directed to that quarter—of old celebrated for its fine linen and flax—in order to raise up a powerful rival to the Baltic grower, on whom this country is at present almost exclusively dependent for its supply. It would seem that this opinion is about to be verified, for we learn from the *Forfarshire papers*, that a few tons have been found fully stronger than the corresponding quality of Baltic growth, but that the tow is of less value. It is stated that the Egyptian cargo can be landed at Dundee a few pounds cheaper than the Baltic—a circumstance which, in these times, when cheapness of production is paramount, will more than counterbalance any little deficiency in quality. An entire cargo is said to be made up for the Tay; and if the experiment prove equally satisfactory on a large scale, there can be little doubt that the article will soon form an important branch of trade with Egypt—thereby rendering us less dependent on, and bringing down the prices of the Baltic article.

West Indian Coal.—The coal raised from the mine discovered two years ago, about six miles from Havana, has been tried by the Spanish steam-frigate; and pronounced by the engineer to be excellent in quality—superior to the best English. Analysis shows the coal to consist of the following parts:—Carbon, 71.74; oxygen, 6.32; hydrogen, 8.44; ashes, 13.50 = 100.00. The railroad from the port to the mine is in rapid progress towards completion. As the bed is believed to be very extensive, the enterprising proprietors anticipate handsome profits on their outlay, whenever the West India steamers shall regularly call at Havana for a supply of fuel.

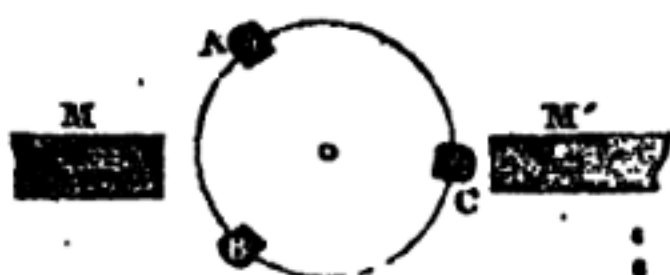


DAVIDSON'S ELECTRO-MAGNETIC ENGINE.,

DAVIDSON'S ELECTRO-MAGNETIC ENGINE.

It is scarcely necessary perhaps to describe the mode of action of an electro-magnetic engine, as we have already so fully explained the laws of electro-magnetism, and shown the structure of several of these engines of different formation; but as this appears to be the only locomotive engine, and one which has justly obtained some celebrity, it is due to fresh readers, although not necessary to our permanent ones, to render the subject perfectly clear; with that view we insert the following account, copied from the *Glasgow Engineer's Magazine*:—

"Let there be a wooden cylinder of convenient diameter, and free to move on its axis, and let A B C, represent the ends of masses of iron grooved into it, and M M', two pieces of iron which we have the power of magnetizing or demagnetizing at pleasure.



In the present situation of the cylinder, suppose M to be magnetic, while M' is not so, then M will evidently attract A more than B; consequently A will be drawn towards M, carrying the cylinder round in that direction. If, when the middle of A has arrived very near the middle of M the magnetism is destroyed and M, endued with magnetism, it will attract B; which, by that time, will be within its sphere of attraction. It is true that when A is immediately opposite M, B and C will be equally attracted by M', but then the momentum which the revolving mass has acquired, acts in conjunction with the force by which M' is drawn towards B, so that the motion is continued in that direction, and as B approaches M' the attractive force is rapidly increased, while that of M' for C is proportionally diminished. By these means rotatory motion may be communicated to wheels, the axle of which passes through the middle of the revolving cylinder. The next inquiry is, how are the bars M M' to be magnetized and demagnetized at the instants required? Knowing that a bar of soft iron is rendered magnetic in virtue of a current of electricity passing along the wire with which it may be coiled, and that whenever that current is by any means broken the iron is no longer magnetic, it becomes necessary to fall upon some method of breaking the line of conduction, and renewing it at will.

"By means of the diagram No. 1 in the cut, we shall be enabled to explain this contrivance, and, indeed, almost the whole that requires explanation in connexion with this class of electro-magnetic engines. Let M and M' represent two electro-magnets, by means of which rotatory motion is to be given to the cylinder between them, furnished with masses of iron as formerly described. Near each end of the axle which passes through the large cylinder are two smaller cylinders. Each of these cylinders has the half of its rim next to the larger cylinder entirely covered with metal, so that it is a conductor of electricity. The outer halves O O', are only partly covered with metal, the intervening portions being of ivory, well-oaked wood, or some other non-conductor of electricity. We shall suppose the dark spaces on the belts O' O, to represent the

conducting parts, and the white spaces the non-conducting parts. Now, suppose one end of the wire which is coiled round the iron M to be connected with Z, one pole of a battery, and the other end of that wire a to rest on c, the metallic rim of the right hand small cylinder; while the wire K b from the other pole of the same battery rests on a metallic part of the rim o: in this case the circuit is complete. From the end Z of the battery the electricity traverses the coil and the other connecting wires in the direction pointed out by the arrows; for the ends of the wires a b, though not in contact, rest on the same metallic surface—M is, therefore, an electro-magnet, (in virtue of the current of electricity traversing its coil,) and will be acting on one of the iron masses fixed on the large cylinder. By directing attention to the position of the wires e d, on the opposite small cylinder, it will be seen that e rests upon a non-conductor, so that the electricity cannot pass from d to e, or the current, which would otherwise traverse the coil on M', is interrupted, and, consequently, M' is not magnetic. As the cylinder revolves, e and d will at length both rest on the same conductor, and M' will be magnetized; while, at the same time, a non-conducting part of the opposite cylinder will have reached b, and M will lose its attractive power. Such is the very simple manner in which the voltaic currents which traverse the coils are interrupted and renewed, in order alternately to demagnetize and magnetize the inclosed nuclei of soft iron.

"After the above details we trust that no one can fail to understand thoroughly the nature and construction of Mr. Davidson's Electro-Magnetic Locomotive—a general representation of which is given in cut No. 2. The two batteries at the front of the carriage serve to communicate power to the four large electro-magnets nearest to them. A pair of these magnets is placed on each side of the large cylinder, through the middle of which the axle of the front wheels passes. The pair on the right, and the pair on the left of the large cylinder, act alternately on the masses of iron grooved into that cylinder, and communicate motion to the front wheels, the magnets receiving and being deprived of power in the manner already described. By the very same means, as the drawing indicates, motion is communicated to the hind wheels of the vehicle, and locomotion ensured.

"There are some points connected with the construction of separate and important parts of the vehicle which require notice; and first of the batteries. These are formed of pairs of iron plates, with an amalgamated plate of zinc interposed between each pair—a description of battery which Mr. Sturgeon, in 1829, found to be superior, in point of economy and action, in all cases where quantity without high intensity is required. The plates are 15 inches deep, and 12 broad. There are four batteries, two at each end of the carriage, in all containing 40 zinc plates. Each battery is arranged so that it can be raised from its wooden trough, or sunk in it, by means of a wheel and axle fixed in a frame above. The original extent of battery surface amounted to what we have mentioned, but Mr. Davidson, finding it insufficient, mounted an additional battery on each side of the carriage on the part of the platform between the wheels. These batteries have 19 pairs of iron plates, with zinc ones intervening, all of the same size as in the former batteries. When the carriage was tried on the Edinburgh and Glasgow Railway

the whole of the batteries were put in action. The carriage is 16 feet long, and 6 feet broad, and weighs above 5 tons, including batteries, magnets, &c. Its rate of motion was about 4 miles per hour. The engineer will easily see that a fraction of a horse power was all that was requisite to produce this effect on a level railway; and, from knowing the work done by some of Mr. Davidson's smaller machines, we anticipated a much greater velocity with such an extent of battery. It is, however, among the first experiments on a grand scale, and we have no doubt will in time lead to much more gratifying results.

"The electro-magnets are not one solid piece of iron as is generally the case, neither are they rounded behind. Each of the side parts or arms is constructed of four plates of soft iron, put together so as to form as it were a box, for the sake of lightness. The arms are 25 inches long, and joined together behind by plates of iron. Their rectangular poles measure 8 by 5 inches, and at their nearest points are only about 4 inches asunder. The coils with which they are surrounded do not consist of a single copper wire, but of bundles of wire wrapped round with cloth to ensure insulation. According to Mr. Davidson's first arrangement, these magnets were placed so that their poles were nearly in contact with the revolving masses of iron in their transit; but so prodigious was the mutual attraction, that the means taken to retain the magnets and iron in their assigned positions were insufficient. They required to be more firmly secured, and their distances had to be somewhat increased, by which considerable power was lost.

"The result of Professor Jacobi's experiments on the water, and of Mr. Davidson's on the railway, will no doubt disappoint the exaggerated expectations of some, who may view them as rather unfavorable to the claims of electro-magnetism; but it must be kept in mind that it is only a few years since it, in any degree, engaged attention as a means of obtaining mechanical power; and, indeed, it could not have done so earlier, the connexion between electricity and magnetism being so very recent a discovery.

"Should it ever lead to the results anticipated from it as a prime mover, there are many advantages which it will possess over steam. The clash, din, and concussion occasioned by steam-engine machinery, the dread of explosions, and the smoke, dust, and danger of fire, would all be got rid of. The only noise in an electro-magnetic locomotive or boat would be that of the wheels, and the batteries could be charged in such a manner as to avoid all disagreeable smell. But even if the method of exciting them should be such as to produce hydrogen gas, this, instead of being permitted to escape and annoy passengers, could be collected and rendered available as a means of producing light and heat when required. So far, however, as light is concerned, it could be obtained otherwise at no additional expense; for a piece of charcoal, being interposed at a small breach in the wires connected with the batteries, would, by its ignition, afford the most intense and brilliant light imaginable, and furnish the means also of communicating signals to an immense distance.

"We are inclined to think that the application of this new prime mover to navigation, particularly on the ocean, holds out better hopes of success than its application to locomotives on land. Iron vessels have now been proved well adapted for duty at sea:

and since that metal and salt water constitute two important elements of a voltaic battery, may some means not be suggested of introducing the third element, so that a great part, if not the whole of the surface of the ship, may be called into action for the purpose of furthering her progress, thus, making the ocean so far her propeller, as well as support, while her own body also performed two important offices? Much less weight would also require to be carried by an electro-magnetic boat than by a steamer, and she could, therefore, undertake much longer voyages."

BLEEDING OF TREES FOR THE SAP.

To obtain the greatest store of sap in the shortest time from the body of a tree, bore it quite through the pith, and the very inner rind on the other side, leaving only the bark unpierced on the north-east side. This hole to be made sloping upwards with a large auger, and that under a large arm near the ground. This way, the tree will in a short time afford liquor enough to brew with; and with some of these sweet saps, one bushel of malt will make as good ale as four bushels with ordinary water. The sycamore yields the best brewing sap.

The change of weather has a great effect on the bleeding of plants. When the weather changes from warm to cold, birch ceases to bleed, and upon the next warmth begins again; but the contrary obtains in the walnut-tree, and frequently in the sycamore, which upon a fit of cold will bleed plentifully, and, as that remits, stop. "A morning sun after a frost will make the whole bleeding tribe bleed afresh. From the latter end of January to the middle of May trees will bleed. Those that run first, are the poplar, asp, abels, maple, and sycamore. Some, as willows and the birch, are best to tap about the middle of the season, and the walnut towards the latter end of March. When a large walnut will bleed no longer in the body or branches, it will run at the root, and longer on the south or sunny side than on the north or shady side. A culinary fire will have the same or a greater effect than the sun, and immediately set trees a bleeding in the severest weather. Branches of maple or willow cut off at both ends, will bleed and cease at pleasure again and again, as you approach them to, or withdraw them from the fire, provided you balance them in your hand, and often invert them to prevent the falling and escape of the sap; but at length they cease. A birch will not bleed; however deeply the bark only may be wounded, it is necessary to pierce into the substance of the wood.—*Dr. Tonge in Phil. Trans.*

THE PRINTING PRESS.

THE important article of the printing press, to which our country, and indeed the whole world, owes so much of civilization and enjoyment, has now arrived to a degree of perfection of which the earlier printers could have no hopes. It generally happens, that when any really valuable machine is invented, it soon becomes greatly improved by the ability or experience of those who have to use it, but this does not seem to have been the case with the printing press; for from the very earliest introduction of printing into Europe in 1440, until the iron presses of Earl Stanhope in 1800, there does not appear to have been any material improvement suggested; and even now the old wooden press is used in numerous

country printing offices, while in foreign countries and in our colonies, such are still of more frequent occurrence than even iron presses: nor will they perhaps be wholly laid aside for many years to come, on account of the very much less price which they originally cost; an object of considerable moment with young printers, or those whose funds are scarcely adequate to the first outlay required, which for a printer's business is considerable even with the greatest economy. Nor are wooden presses to be altogether despised, as many of our best and most beautiful works have been printed by their means; of this any person will be convinced who examines books printed previously to 1800 with those of the present day. To assist persons who may be resident far from the assistance of press makers, or abroad, we purpose to give a clear description of the wooden press in its details and proportions, as preliminary to some future remarks we may have to make relative to iron presses. The following is the general appearance of the press when put up:—



The press consists of the following parts: the feet, cheeks, cap, winter, head, till, hose, garter, hooks, spindle, worm, nut, eye of the spindle, shank of the spindle, toe of the spindle, plattin, bar, handle of the bar, hind-posts, hind-rails, wedges of the till, carriage, outer frame of the carriage, iron ribs, wooden ribs on which the iron ribs are fastened, stay of the carriage, coffin, plank, gallows, tympane, frisket, points and point screws. These are the different names of the parts of the press; but to convey a more perfect idea of its construction, we shall present our readers with engravings of the respective parts, and their proportions.

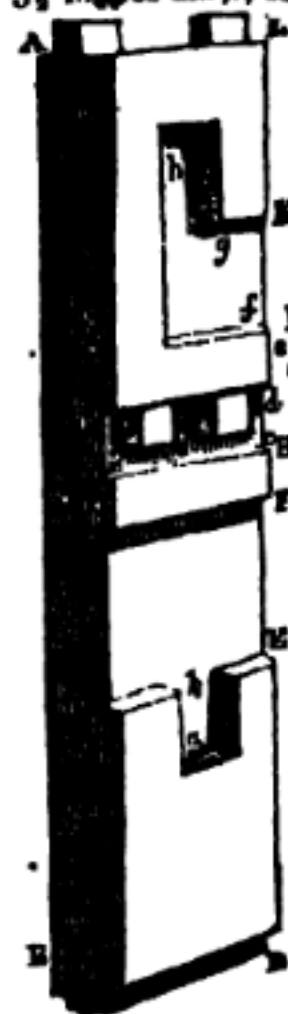


A to B, 3 ft. 1 in. and 5 in. square.

The Feet.—The feet are 3½ inches long, and 5 inches square: the distance asunder, 1 foot 10 inches—3½ inches from each end, the mortise holes are to be made on the middle of the breadth of the upper side of the foot, for receiving the tenons of the cheeks and hind-posts. The mortise holes for the cheeks are 8 inches long; those for the hind-posts, 2½ inches, and 1 foot 7 inches asunder. For the sake of ornament, the ends may be bevelled off according to the taste of the joiner, but care must be taken not to weaken them by so doing.

The Cheeks.—The cheeks are 6 feet 1 inch long, and 8½ inches broad, and 5 inches thick, with a tenon at each end. The lower tenon enters the

fore part of the foot, and is cut 8 inches long, and 3½ inches deep, to fit the mortises. The tenon at the

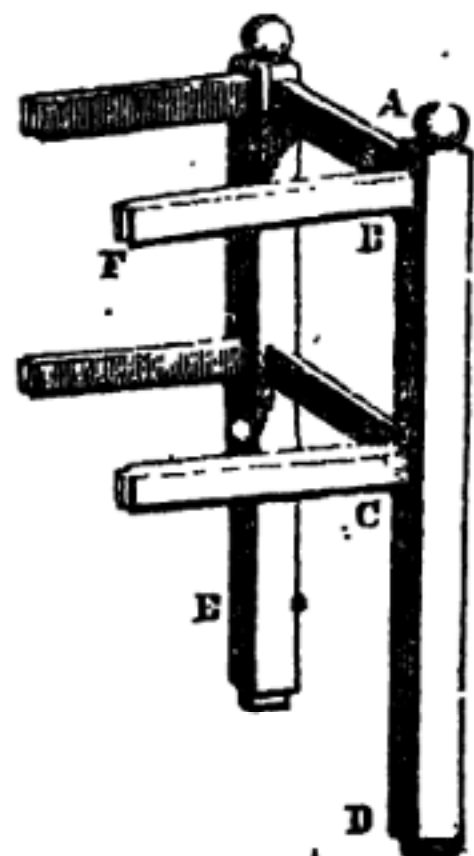


upper end of the cheek is cut across the breadth, and enters the cap within ¼ an inch of the top. The cheeks and the feet are fastened together with two wooden pins, distant from each other about 3 inches.—2 feet 11 inches, from the bottom of the cheek, one half of the thickness of a foot, and an inch long, is cut away, to admit a free passage for running in and out of the coffin. In the middle of the lower shoulder of this cutting-away, is a mortise of 7½ inches long, and 3 inches wide, in which is fitted a tenon made at each end of the winter.—4 inches from the upper part of this cutting-away, another is made of the same depth 2½ inches long, to admit a block 2½ inches thick, of the width of the cheek, on which the till rests. Above this, two mortise holes are made, 2½ inches long, corresponding with the tenon

at the end of the till; 3 inches above the till, another piece is cut away, 9½ inches long, and 4 inches wide, half through the breadth of the cheek, to admit the depth of the head. Just above this cutting in, is made a square mortise in the middle of the cheek, 2 inches wide and 8 inches long, for the tenons of the head to play in.

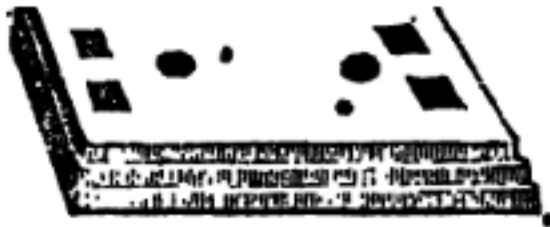
A to B	6 ft. 11	0 ft. 9½ in.
B to C	0 3½	1 2
D to E	1 10	0 7½
E to F	1 1	0 2½
F to G	0 4	0 2½
G to H	0 5	0 9½
H to I	0 3	0 8

The Hind Posts and Rails.—Six rails are fitted into the hind-posts, two of them behind, and two on each side; one of the hind-rails to be placed 2 inches from the top, the other level with the upper side of the winter. These two rails are tenoned at each end, and made so long that the posts may stand even with the cheeks. These tenons are let into mortises made in the insides of the hind-posts, and fastened in with wooden pins. The side-rails are tenoned at each end, and let into the mortises made in the cheeks and hind posts, and fastened in the same manner by the hind-rails. In the centre of the lower hind-rail, one of the girths is either nailed or fastened with a screw.

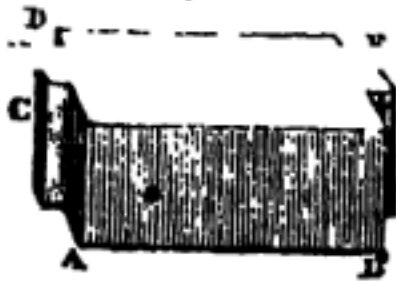


The height or length of the posts from A to D, 4 ft. 2 in.	
Their distance asunder, from B to E	2 2
Length of the rails from B to F	1 6
Their distance asunder from B to C	1 3½

The Cap.—The cap is 3 feet long, 11 inches wide, and 4 inches thick. The front and two sides are ornamented with a neat moulding; the front projecting about $1\frac{1}{2}$ inches, and the sides $3\frac{1}{2}$ inches, over the cheeks. About 3 inches from each end, two mortise holes are made, to admit the tenons of the cheeks; also two holes through which the head bolts pass.

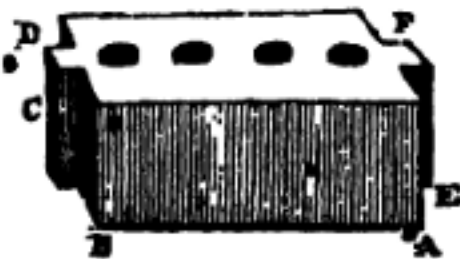


The Winter.—The length of the winter, exclusive of the tenons, is 1 foot 11 inches; the width, $9\frac{1}{2}$ in.; the depth, 9 inches. The projection of each of the tenons is 2 in. These tenons are made the whole depth of the winter, to fit and fall into the mortises in the cheeks.



Length from B to A.....	1 ft. 11 in.
A to C.....	0 9½
C to D.....	0 9
Projection of the mortises F and E..	0 2

The Head.—The length of the head, exclusive of the tenons, is the same as the winter, viz. 1 foot 11 inches; the width, 9 inches, and the depth, $10\frac{1}{2}$ inches. The projection of the tenons, 2 inches. The front of the head projects $\frac{1}{2}$ an inch over the range of the front of the cheeks. The tenons, like the winter, are also cut from the top to the bottom of the head, and made to fit easily into the mortises in the cheeks. In the centre of the bottom of the head, a hole is cut about 4 inches square and $3\frac{1}{2}$ deep, to admit the brass nut in which the screw of the spindle works. This nut is secured and kept in its proper place by means of iron bolts, about $\frac{3}{4}$ of an inch square, and $9\frac{1}{2}$ inches long, which go quite through the head, having at their ends a hook turned square, to clasp upon the under side of the nut. At the top of these bolts there are screws that project about an inch above the head, which, by the help of nuts and washers, draw the hook of the bolts close against the nut, and thereby keep it in a fixed and a perpendicular position. In the centre of the top of the head a small, round hole is bored, to admit oil into the nut and spindle when necessary.

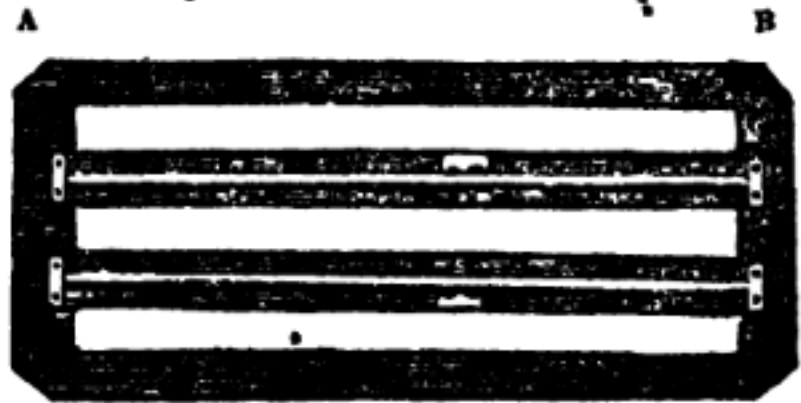


The length from A to B.....	1 ft. 11 in.
Depth from D to E.....	0 10½
Width from H to C.....	0 9
Projection of the mortise D and F.....	0 2

Three inches from each end of the head, two bolts pass through that and the cap, of 20 inches in length, and about $\frac{3}{4}$ of an inch square. These bolts have a square head, which stop against and are let in level with the under side of the head. They have coarse screws at the top, which are furnished with nuts and washers. Upon these bolts



rests the weight of the head, and by them the head is screwed up or let down as occasion requires.



Length from A to B, 5 ft., Width from A to C, 2 ft. 2 in.

The Carriage and Ribs.—The carriage is a frame of 5 feet long, and 2 feet 2 inches broad, on which the ribs are placed. The two end-rails are each 4 inches thick, and the side-rails, $2\frac{1}{2}$ inches thick. Between the two side-rails, are framed into the end-rails, two wooden ribs, $2\frac{1}{2}$ inches broad, and $1\frac{1}{2}$ inch thick. They are placed at an equal distance from each side-rail, and the same distance between each other. Upon these the steel ribs are fastened. These ribs are made about 4 feet 8 inches long, and an inch thick. The uppermost sides, on which the cramps rest, are of a convex form, the others perfectly flat. The two ends are flattened to about a $\frac{1}{4}$ of an inch thick, and holes drilled for the purpose of fastening them to the end rails. In the middle of the outer end of each rib, a small piece of iron, about a $\frac{1}{4}$ of an inch thick, with holes drilled in it, projects, which is also nailed to the wooden ribs. The inner side of each rib is polished, to admit the shoulder of the two first and two last cramps. This is a late improvement on the common press. It prevents the shaking of the coffin, and the slur on the work which consequently attended it. The ribs must be of an equal height and thickness, and lie exactly horizontal, in straight lines: for the smallest irregularity in this respect will affect the cramps, so as to render some of them useless.

(To be continued.)

SUGAR FROM THE APPLE, &c.

BY M. DUBUC.

SEVERAL establishments have been made in the South of France for making sugar from grapes; it is therefore desired to communicate the same advantage to the North of France, as apples and pears will produce sugar whose taste is equally agreeable as that of grapes, and equally cheap.

Eight quarts of the full ripe juice of the orange apple was boiled for a quarter of an hour, and 40 grammes of powdered chalk added to it, and the boiling continued for ten minutes longer. The liquor was strained twice through flannel, and afterwards reduced by boiling to one half of its former bulk, and the operation finished by a slow heat until a thick pellicle rose on the surface, and a quart of the syrup weighed 2 pounds. By this method 2 pounds 1 ounce of liquid sugar was obtained, very agreeable in flavor, and which sweetened water very well, and even milk, without curdling it; 8 quarts of the juice of apples called *Doux levenque*, yielded by the same process, 2 pounds 12 ounces of liquid sugar; 8 quarts of the juice of the sour apples called *Blanc mollet*, yielded 2 pounds 10 ounces of good sugar; 8 quarts of the juice of the watery apples called *girard*, yielded 2 pounds and a half; 50 pounds of the above four apples yielded nearly 42 pounds of

juice; which took 3 $\frac{1}{2}$ ounces of chalk and the white of six eggs, and produced more than 6 pounds of excellent liquid sugar.

In order to do without the white of eggs, 20 pounds of the juice of the above apples were saturated with 11 drams of chalk, and repeatedly strained through flannel, but it was still thick and disagreeable to the taste; 12 drams of charcoal powder were then added, and the whole boiled for about ten minutes, and then strained through flannel; it was then clear, but higher-colored than usual; however, it produced very good sugar. Six quarts of apple-juice were also treated with 7 drams of chalk, and 1 ounce of baker's small coal previously washed until it no longer colored the water with the same effect. Eight quarts of apple juice, of several different kinds and in different stages of ripeness, of which one-third was still sour, were saturated with 12 drams of chalk, and clarified with the whites of six eggs; some malate of lime was deposited in small crystals towards the end, and separated by passing the syrup very hot through the flannel. Very near 2 pounds of sugar were obtained.

Ten pounds of bruised apples similar to the last, were left to macerate for twenty-four hours, and 4 quarts of the juice were treated with 5 drams of chalk and the white of an egg; it yielded 1 pound 6 ounces of liquid sugar, so that the maceration had been of service; 24 pounds of the pear called *pil-lage*, yielded 9 quarts of juice, which required 18 drams of chalk and the whites of two eggs, and yielded about 24 ounces of sugar, which was less agreeable to the taste than that of ripe apples; 6 quarts of juice from one part of the above pears, and 2 of ripe apples, (*orange* and *girard*), treated with 8 drams of chalk and the whites of two eggs, yielded 26 ounces of very fine tasted sugar, superior to the preceding; 6 quarts of juice of an equal quantity of apples and pears, treated with 10 drams of chalk and 13 of prepared charcoal, deposited some malate of lime, and yielded a sugar rather darker than the preceding, but very well tasted.

Cadet de Vaux says, that apple juice does not curdle milk, and that a small quantity of chalk added to it destroys some part of the saccharine principle. But 8 quarts of juice from ripe apples called *orange*, which was evidently acid, as it curdled milk and reddened infusion of turnsole and that of violet, were treated with 4 drams of chalk and the white of an egg; it yielded 22 ounces of syrup, between 32 and 33 degrees of the hydrometer, which did not curdle milk. Another 8 quarts of the same juice evaporated to three-fourths of its volume, and strained, yielded 23 ounces of clear syrup, which curdled milk, and was browner than that of the neutralized juice, and approached towards treacle in smell and taste. Perhaps the apple called *Jean-Aure*, used by Mr. Cadet, possesses the valuable properties of furnishing good sugar by mere evaporation. It is necessary to observe, that unless the fire is slackened towards the end the syrup grows brown, and acquires the taste and smell of burnt sugar. A cwt. of apples yield about 84 pounds of juice, which produces nearly 12 pounds of liquid sugar. Supposing, therefore, the average price of apples to be 1 franc 20 cents (10d.) the cwt., and the charge amounts to 40 cents (4d.), good sugar may be prepared for 2d. per pound. The only extra apparatus necessary is a couple of copper evaporating pans.

REVIEW.

A General History of Infusorial Animals, Illustrated by 500 Engraved Drawings, being Part I. of a History of Infusoria Living and Fossil. By A. Pritchard, M.R.I.

THE works of Mr. Pritchard on subjects analogous to the above are already well known, as also his list of microscopic objects; and our readers who take interest in the wonderful developments of the minuter parts of creation, which the perfection of modern microscopes exhibit to our view, will be glad to know that Mr. Pritchard still continues employing his talents and experience in the same pursuit in which his former labors were so successful. The present work, we hesitate not to say, surpasses considerably all the former, in beauty, cheapness, and accuracy. There are no less than 500 delicately engraved figures of animalcules, together with their whole general history, and a list of their classification into families and tribes, for such a mere trifle as 5s. The work is too cheap, and nothing but a very large sale will cover the expenses. This being Part I. the work evidently will be continued, the following parts containing a more minute detail of the creatures here represented and introduced. We find also, from a list in page 76, that the second part will describe 732 of these minute animals, and we presume complete the work. It has been usual with us only to review those works which are good, suffering others to pass unnoticed, and to give an extract or two to enable our readers to judge whether we are right in the remarks we venture to offer. We shall do the same upon the present occasion, and introduce a page from Mr. Pritchard's book, not perhaps the best, and certainly not chosen as such, but one which we believe is most likely to interest our readers.

CAPTURING, SELECTING, AND EXAMINING INFUSORIA.

"Having provided yourself with a number of clean glass wide-mouthed phials—those containing about four ounces a-piece will be found most suitable—let them be fitted with proper corks, and not with glass stoppers. If it be required to have all the tackle neatly arranged, they may be put into a small case, expressly constructed for the purpose, and each bottle separately marked. In place of phials, however, cylindrical glass vessels, from three to five inches long, may be substituted with advantage, as they will lay better in the case, which need not exceed the dimensions of a common sandwich-box. A good walking-stick, with a hook at the end of it, and a piece of twine, should always form part of the equipment. As the margin of small ponds is sometimes difficult of near approach, I have contrived a spring-book, which is attached to a moveable ferule, and made to fasten to the end of the walking-stick. This lays hold of the neck of the phial, and enables you to charge it from the surface of the water, in the immediate vicinity of the stalks of water-plants, a situation generally abounding with Infusoria. Take with you, also, a pocket magnifier, of shallow power. This may be mounted in various ways; but the one I prefer is the triple, having the lenses arranged in the same plane; the convenience of which is, that you will have three different powers always ready for use, without the necessity of moving them; and that, the mounting being flat, it will be very suitable for the waistcoat pocket. Sling this with a piece of ribbon, about the neck, and there will be

no danger of losing it. The magnifying powers usually selected are those from five to fifty diameters; the first, or largest, serving to distinguish the masses; the intermediate, to show the general movements, so as to determine pretty nearly whether the water you have collected is worth retaining or not; and the smallest, or most powerful, for examining the contents with more minuteness. This latter power will not so frequently be called into use abroad as at home; because, with a little practice, the middle and shallow powers will be found to answer every purpose.

"Having now mentioned all the needful apparatus, proceed to the nearest ponds of water in the neighbourhood, and should there be healthy *lemnæ* on their surface, or *confervæ*, or other aquatic plants, you will be almost certain to meet with animalcules. If there be any drains, however, communicating with them, the chances are that they contain only the common species, which will, by a little practice, be readily distinguished by their motion, general appearance, and color. The indications of the presence of infusoria are specks moving about in the water, or an apparent mouldiness round the stalks of the *lemnæ*, &c. Should these appearance not be discerned under the middle power of your magnifier, throw away the water, and repair to some more favored pool. Be careful to take only a small portion of vegetable matter in your vessel, as its decay, and consequent evolution of gas, may soon kill all your animalcules. This must be constantly borne in mind. Clear pools of water, in the spring of the year, are the favorite places of resort for the *volvox* globosus; clear water, slowly running in clay or chalky soils, for the *bacillaria* and *arcellina*. House gutters, and tubes placed to receive the rain water; often contain a rich supply. In the winter, you may search for them in water among dead leaves, reeds, &c., which may be taken out, and their contents shaken off into some clear water; while the species which attach themselves firmly to these objects may be examined without their being removed from them. Dr. Ehrenberg states that he has met with good success in the winter under bridges, around the piers and outworks, and even in frozen ditches beneath the ice. When you have filled your vessels, cork them carefully, so as to exclude the air, for the shaking of the carriage, when a quantity of air is left in the vessels, will often destroy them before you arrive at your place of destination. In this respect, my mode of proceeding differs from that of Dr. Ehrenberg, who always leaves a small proportion of air in the vessel; judging, therefore, from my own experience, I should conclude that he is more careful than myself as to their conveyance. The only inconvenience I have experienced from keeping the vessels entirely filled with water, during the short time of transporting them home, has arisen from those creatures which appear to live on the surface, attaching themselves to the cork, and remaining so when required to be taken out. Remove the corks as soon as you get home, and place the vessels upright; for which a magnifying stand, furnished with a number of holes adapted for the vessels, will be very convenient. A gauze covering fitted to the frame, will keep out the dust and blacks, without obstructing the free ingress of air.

"We now proceed to the mode of investigating these minute creatures under the microscope. If the kind to be examined are those which swim freely, and are visible to the naked eye, as the *volvox*, *bursaria*, and other large *polygastrica*, and also the free

rotatoria, take a small open glass tube, such as is described in the *Microscopic Cabinet*, p. 236, and select the specimens with it in the manner there recommended. The diameters of these tubes may vary from one-eighth to one-twelfth of an inch, and their length from four to six inches. It may be useful occasionally to draw out and slightly bend the extremities which are to be immersed in the water.

"When the creatures are more minute than those above mentioned, pour a little water from the vessel containing them into a watch glass, and place it upon a piece of cardboard, rendered half black and half white. The white ground will make the dark specimens apparent, and *vice versa*; thus, the required specimens may be taken out singly with one of the tubes, and placed in the aquatic live-box for observation. The observer will derive much assistance in this operation from the use of the pocket-magnifier before mentioned, or from a watchmaker's eye-glass.

"When the infusoria are extremely minute, they usually congregate at the edge of the water over the white portion of the cardboard, and may be removed from thence with the point of a quill, or a small wedge-shaped pencil. If a quantity of the chara, or other aquatic plants, be put into a glass jar with the infusoria, in the course of a few days more or less depending upon the temperature of the season, the surface will be covered with a thin pellicle, formed by the decomposition and extrication of gas, causing the small detached pieces of vegetable matter to float upon the water, and with them the infusoria. Let a small portion of this film be taken from the surface, by means of the feeding pin, described in the *Microscopic Cabinet*, p. 235, and examined under the microscope, and you will hardly fail of being highly gratified. Among the most interesting genera collected from the surface of these infusions, in the manner just stated, are those belonging to the families of *arcellina* and *astasia*. After the film has remained some days upon the water, many of the above-mentioned genera disappear, and are succeeded by those of the family *vibrionia*, especially the *bacterium*. These, however, may be easily overlooked; for they merely resemble, even under a power of 250 diameters, scintillations, or the vibrations of cilia, among the vegetable matter. But when carefully examined under a deeper power, they will appear like so many short rods, each rod, or chain, having a distinct movement of its own.

"Although such exceedingly small creatures as animalcules, when dead, lose many of their characteristic features, especially the soft-bodied ones, yet, for the verification of some parts of their structure, it is absolutely necessary to observe them in a quiescent state; and hence, a method of effectually drying and preserving them must be considered essential. *Bacillaria*, in this condition, have often been preserved by botanists, in collections of minute algae, and with very little management, but other families will require more care. Having selected the creature you wish to preserve, remove it with a fine pointed quill, and put it on a slip of glass, or other convenient receptacle. By this means there will be but a small portion of water surrounding it, which may be extracted by some pointed pieces of ragged blotting paper. When you have withdrawn as much of the water as possible from the specimen, the remaining moisture may be readily evaporated, by placing the glass on the palm of the hand. The *hydatinea* may be best preserved when destroyed with strychnia, and then rapidly dried. By what

mode soever life may be taken away, it is absolutely expedient that they should be speedily and carefully dried, otherwise their bodies will be decomposed, gases evolved, and the object will fail.

"The best way of mounting for the microscope dried infusoria will be on slips of plate glass, having a polished circular cavity, in which to deposit the creatures. These may be numbered, or otherwise marked, with a writing diamond, and a large collection of them arranged in a very compact case. Fossil infusoria are best preserved in Canada balsam, under thin slips of glass.

"Infusoria, when simply dried, may be relaxed again by moisture, and some of them will bear this operation several times--the soft-bodied ones, however, only once. The general color of infusoria is retained for a considerable time after they have dried, but the pigment of the eye is soon lost. It may be well to observe, that when the preserved specimens are intended to illustrate the nutritive system, they should be previously fed with coloring matter; but for observations on their muscular system this is not advisable.

MAKING PICTURES OF BIRDS, WITH THEIR NATURAL FEATHERS.

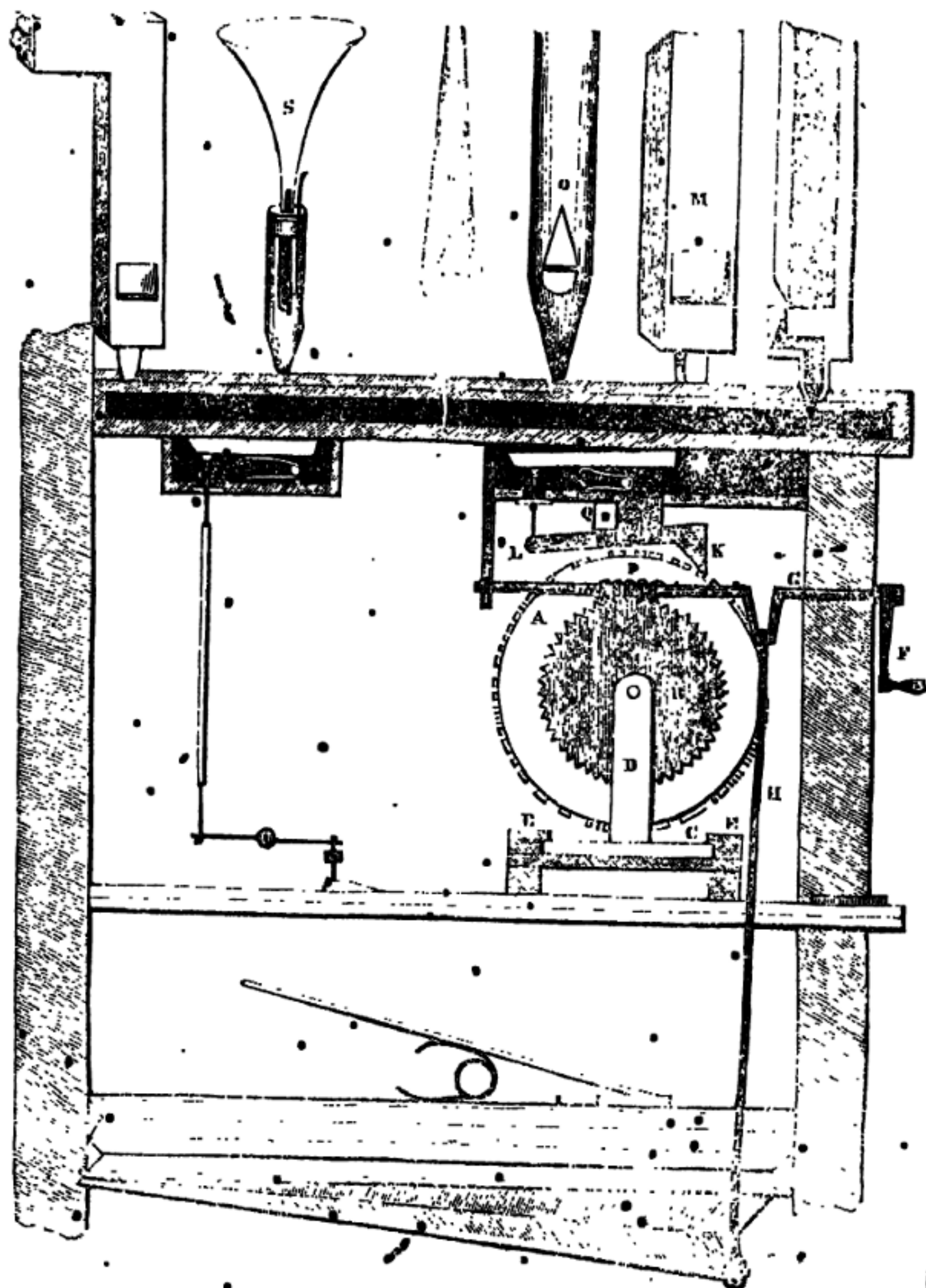
First take a thin board, or pannel of deal, or wainscot, well seasoned, that it may not shrink; then smoothly paste on it white paper and let it dry; and if the wood cast its colors through, paste on a second paper and it will be whiter; let the second paper dry, then get ready the bird to be represented, and draw it as exact as may be on the papered pannel, of its natural size (middle sized birds are the best for this purpose), then paint the ground work, or tree, or other thing intended to set the bird on, together with the bill and legs of the bird in water colors, leaving the bird to be covered with the feathers. First prepare the part to feathered, by laying on pretty thick gum-arabic water, with a large hair pencil, then lay the pannel flat and let it dry hard, and when dry, cover it with gum water a second time, and let it dry, and then a third, in case it do not lie with a good body on the paper, (the thickness of a shilling when dry is sufficient). When the piece is thus prepared, take the feathers off the bird, beginning at the tail and points of the wing, and working upwards to the head, observing to cover that part of the draught with the feather that is taken from the same part in the bird, letting them fall one over another in their natural order. The feathers must be prepared by cutting off the downy part that is about their bottoms, and the larger feathers must have the inside of their shafts shaved off, to make them lie flat; the quill of the wings must have their inner webs clipped off, that, in laying them, the gum may hold them by their shafts. In laying them on, take a pair of steel pliers to hold the feathers in, and have some gum water, not too thin, and a large pencil ready to moisten the gummed ground work by little and little as it is worked; then lay the feathers on the moistened parts, which must not be waterish, but something sacky or clammy, to hold the feathers. A parcel of small leaden weights, in the form of sugar-loaves should be prepared, which may be cast in sand, by first making holes in its surface with a pointed stick; these weights will be necessary to set on the feathers newly laid on, to hold them to the gum, till they are dry and fixed; but be cau-

tious lest the gum come through the feathers, for it not only smears them, but sticks to the bottoms of the weights, and will be apt to pull off the feathers with the weights, which will disorder the work. When the bird is wholly covered with feathers, stick on (with a little thick gum) a piece of paper, cut round, of the bigness, and in the place of the eye, which must be colored like the eye of the bird; when the whole is dry, dress the feathers round the outline that may chance to start a little, and rectify what may be mended in any other part; then lay a sheet of clean paper on it, and on that a heavy book, or some such thing, to press it; after which, it may be preserved in a frame covered with a glass.

COVERINGS FOR ROOFS.

FROM the variety of coverings that are used in common it is evidently undecided by builders whether slates, lead, copper, or tiles are best. The several substitutes for materials of this kind that have lately been proposed it may be presumed do not answer from their very rare adoption, it being well known that builders are always alive even to the most trifling points of economy in building a house. The four substances we have mentioned may therefore perhaps be considered the principal, if not the only materials generally approved of. For flat roofs, copper or lead appears to be indispensable, and the economy of these (which are both very durable) will depend upon their relative prices at the time. The thickness of copper for such purposes should not be less than 16 ounces the superficial foot, that of lead of seven pounds to the same measurement. It follows as a corollary that the timbers to support the lead should be seven times as strong as those for copper, to support its superior weight.

With respect to tiles and slates it has been ascertained that a square of 100 superficial feet will take of slates, upon an average, about 7 cwt.; of pantile, 9½ cwt.; of plain tiles, 18 cwt. Slates absorb no moisture, or so little as need not be brought into the calculation; tiles absorb about a seventh part of their weight. Therefore it may be said in round numbers, that the timbers to support pan-tiles should be 1½ times as strong as for slates, and for plain tiles three times as strong. It may not be amiss to add here an account of an experiment made by the Bishop of Landaff on the absorption of water by tiles and slates. He observes, "I took a piece of Westmoreland slate, and a piece of common tile, and weighed each of them carefully; the surface of each was about 30 square inches; both the pieces were immersed in water for ten minutes, and then taken out and weighed as soon as they had ceased to drip, and it was found that the tile had imbibed about ⅓ part of its weight of water, and the slate had not imbibed a 200th part of its weight. Indeed the wetting of the slate was merely superficial, while the tile in some measure became saturated with water. Both the wet pieces were now placed before the fire; in a quarter of an hour's time the slate had become quite dry, and of the same weight it had before it was put into the water; but the tile had only lost 12 grains of the water it had imbibed, which was as near as could be expected, the same quantity which had been spread on its surface, for it was this quantity only which had been imbibed by the slate, the surface of which was equal to that of the tile. The tile was left to dry in a room heated to 60° of Fah., and it did not lose all the water it had imbibed in less than six days."

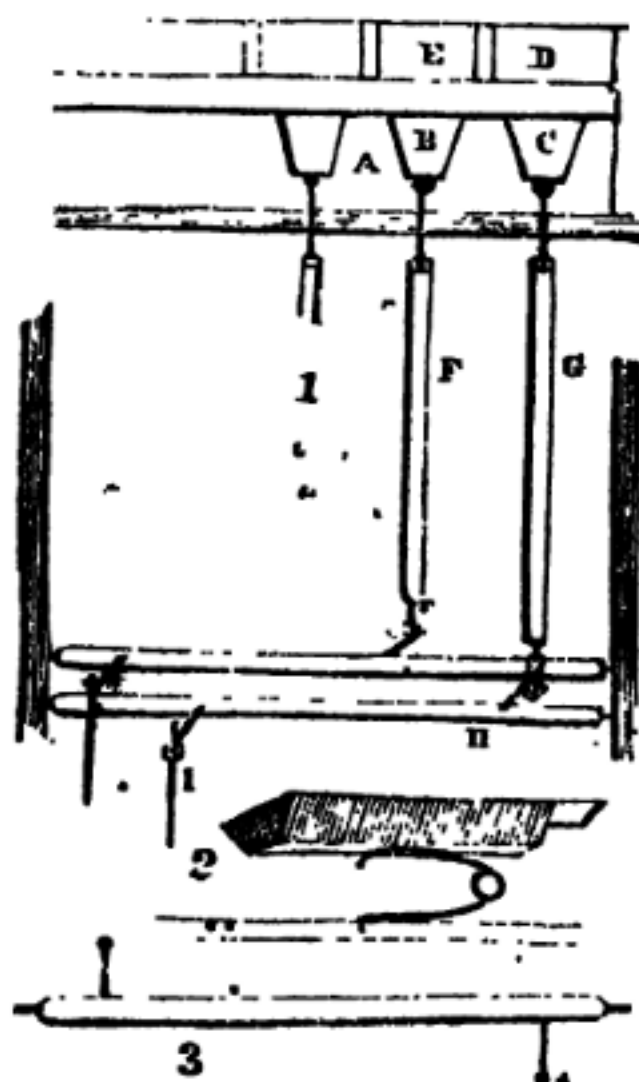


STRUCTURE OF THE ORGAN.

STRUCTURE OF THE ORGAN.

(Resumed from page 333, and concluded.)

IN the last paper upon this subject we described the manner of making the valves and of fixing them: thus completing the whole internal structure of the organ, with the exception of connecting the valves with the keys, and the contrivance to keep the valves to their places, so that they shall not fall down by their own weight, and consequently suffer the air to pass beneath them. The latter we shall describe first, as the most simple. Any spring fixed beneath each valve will answer the purpose; one made of wire of such a form as is represented in fig. 2 beneath will be found most convenient. The wire spring is to have two projecting ends, and a circle turned in it, as shown, the lower end being driven into the lower boards of the valve box, and to keep it from rocking sideways, a small wire staple may be driven over the lower arm of it at a short distance from its end. The leaders from the valves to the keys are next to be considered, and we will refer to the second paragraph of page 333, in which we made a remark that we should have occasion to show a superior mode of connecting the keys and valves than that shown in a former cut. This will be understood by fig. 1 beneath. Suppose II to be a round piece of wood, supported upon pivots at both ends, and suppose that there are a series of such pieces of wood similarly supported above each other, and equal in number to both the keys and notes of the instrument. Suppose we have a wire projecting horizontally at the back, and also another at the front of this cross bar, as is shown in fig. 3, one of which we suppose to be at I in fig. 1, and the other at the back of II. Of course when we lift up I, by means of pressing down the key, we shall transfer the motion in pulling down the wire at H, and this being connected with the valve above, immediately admits the air to the required pipe, as will be seen not merely in the cut beneath, but sideways in the



leading cut. The leader I will of necessity be over the key lever, the wire II and leader G will be

exactly under the valve C. The various cross bars do not interfere with each other, as is evident by their being supported at different heights, and the wires do not interfere because the valves and keys range laterally. In the example we have shown in the preceding cut, it will be evident, that there is no more difficulty in opening a valve at the right-hand side of the instrument, by a key on the left-hand side, than if the key and valve were over each other; and thus we have it in our power to place the pipes wherever it is most convenient, without involving any intricacy of machinery in connecting them with the keys. As to the composition of the leaders themselves, wood is considered preferable because it is light, and does not expand by heat or cold as metal does. In fig. 1, A represents the valve box; B and C are two valves closed, beneath the channels D and E of the wind chest.

The valve, as before stated, has a small staple beneath, to this hangs a short, stiff, hardened brass wire, perfectly straight and smooth; it bends in a ring or hook above, and is tapped with a screw beneath, which screw afterwards fastens the wooden leader. To let this wire through the whole substance of the bottom of the valve box, and which it is to be remarked is wood $\frac{1}{2}$ an inch thick, would occasion too much friction, or else not be air-tight, making the proper allowance for the swelling or shrinking of wood in different states of the weather. So that it is usual to leave the bottom of the valve box to be put on when the leaders, valves, and springs are all complete, and also to leave the front of the valve box to screw on and take off at all times, in order that when any thing is amiss, the defect may be at any time rectified; and previous to fixing the front by screws, the edges should be covered with wash leather. Although we have recommended not to fix the bottom of the valve box until every thing belonging to it is finished, yet it is finally to be immoveable. But to return, we will suppose then that the valve box at present only consists of its two ends and back, the valves being all in their places, but not yet supported by their springs. Turning your work over for the valves to be uppermost, cut a piece of wood for the bottom of the box of its full length, but only so wide as to reach from the outer edge of the back of the valve box, to about $\frac{1}{4}$ of an inch less than where the staples of the valves are, and which staples should be in an exact line, so that when this board is in its place, the wires which are to hang to the staples shall be clear of this part of the bottom; then make a number of marks along the bottom board, one to each of the valves, and corresponding to the middle of it. Opposite each of these marks, on the inner side, at about $\frac{1}{2}$ an inch from the edge is to be inserted the lower arm of the wire spring, and the whole being ranged properly, this board is to be put in its place: kept there by a temporary screw or two, and the whole turned up to see if the springs work well, and keep all the valves to their places. The springs must not be too strong, or there will not be any delicacy of touch in the instrument, nor too weak, or the valves will leak, so that if the spring keep the valve close, and pull it up with a slight snap, it is sufficient. When all is perfect, fasten this part of the bottom down with glue and screws. Next prepare a second piece of wood to form the rest of the bottom. It is to extend from the front to meet the former piece, all but about $\frac{1}{4}$ an inch, so that the wires of the valves shall hang between the two without touching either. Fasten this piece on, and hang a wire from each

valve; procure a piece of thick brass $\frac{1}{4}$ of an inch thick in the least, the whole length of the valve box, and $1\frac{1}{2}$ inch wide at the least. Brass of this description is sold by the furnishing ironmongers as bands for window blinds. Drill some screw holes along each side, not exceeding 3 or 4 inches from each other. Having the valve box, &c. so placed as that the wires shall hang down freely, place the brass so prepared with screw holes under the wires, and carefully mark upon it where every wire touches; drill holes at all these places carefully through the brass, so that the wires shall have a sufficient, but not too much play. Fasten this brass beneath the two wooden portions of the bottom, and try how the valves play by pulling the wires. In fastening the brass down, either put it upon thin leather, rag, glue, or two or three folds of brown paper. Last of all, fasten on the front of the valve box, continue the leaders to the keys, and the whole machinery is complete.

The foregoing account applies more particularly to the finger organ, a very small addition to it renders it equally adapted for a barrel or self-acting organ, as we shall endeavour to explain by the leading cut on the first page. The bellows, frame, and wind chest applies to both. If a barrel only is to be used, the valve box and valves are to remain the same, but the whole apparatus of keys is done away with. If both barrel and keys are used, there must be two valve boxes and two sets of valves, both made exactly as above explained, the only difference being the method adopted to move the valves, and this is explained in the cut. A shows a round wooden barrel, which ought to be made of alder-wood, and of one piece, 6 inches less than the length of the case; upon one end of this barrel is fixed a wooden wheel, as shown at B. The barrel and its wheel is supported by two uprights, one of which is shown at D, fixed into a foot C, which slides between the two cheeks E E. At one end of the organ case, that is at the end opposite to that we have shown, is a square hole, where the barrel and its frame slides in, so that one barrel may be taken out at any time and another put in, the spindle in the centre of the barrel at the other end merely comes through the case, where by a sliding piece of brass it is set to any required tune, as was explained in an article on pricking organ barrels, in page 140, Vol. II. F is a handle, when this is turned round, it moves the spindle G, and the endless screw upon it A. The screw works the barrel round, and at the same time, by means of a crank and wire H, it works the bellows up and down. As the barrel turns round it lifts up the key K, fastened to the key frame P, and which moves upon a centre at Q. The only use of this being moveable is, that the keys may be lifted up whenever a barrel is taken out or put in, otherwise it is fixed down; we must suppose the frame to be fixed, each key K will therefore, being moved up at one end, be brought down at the contrary end I, and thus open the valve above. It is indeed represented as open. The key K returns to its place as soon as it has passed the impediment or wire staple upon the barrel, and another staple at another part of the barrel is acted upon in the same manner, each producing its own sound.

Organ-pipes are of several kinds, particularly open pipes, closed pipes, and reed pipes. The closed pipe, and what is peculiarly used for the stop diapason, is shown in M and N. The former is the outside representation of the pipe, the latter its internal structure. In the lower part of it is

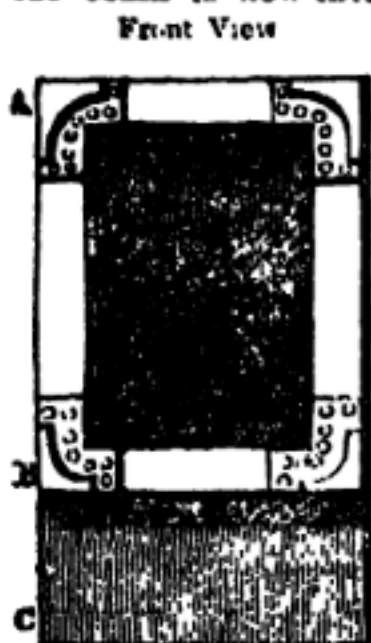
a small pipe with a cavity from $\frac{1}{4}$ quarter of an inch diameter for the smallest pipes, to an inch or more for the largest. This glues into a square block of wood from one to two inches high, and of such a breadth and depth as the internal size of the pipe; a hole is cut sideways in this, quite across the block, with two saw cuts, and the piece taken out. The hole of the wooden pipe below communicates with this cross cut. The blocks being prepared, the back is glued on, and then the sides. These three parts, as well as the bottom, being finished and put together, prepare for fronts, pieces of wood which extend from the top to the block only. Chamfer the lower end off so as to form a mouth as represented in M, the width of the mouth being from a quarter to three-quarters of an inch wide, according to the size of the pipe. Fasten on this piece to the front, and prepare the mouth-piece to go below. This exactly covers the front of the block, and is cut under in the same manner as the mouth of the upper piece was, and as is represented in N. The upper edge is partly cut away, from the sixteenth to a quarter of an inch, as a passage to the air. The air rushes up this channel, strikes against the edge of the mouth, and enters the pipe. The air within that being put in motion resounds, and according to the length of the pipe so will be the note. If the pipe be open, the length of it is considered from the mouth to the top, but if closed, the length of the pipe is from the mouth to the closed top, and thence back again to the mouth; so that a closed pipe, to produce the same note as an open one, must be half its length, reckoning from the mouth upwards. The way in which a pipe is closed is by a square plug covered with leather, which fits air-tight into the top of it; this is drawn up or let down until the proper note is obtained. It is of no consequence whether the pipe be straight all the way, or bent as in fig. T, and this is important to observe, because it enables us to bend the pipes if we are confined for height. To make all pipes speak properly and clearly, it is necessary to cut little nicks, sideways, in the upper edge of the block, where the wind issues against the mouth. The metal pipes and the reed pipes we cannot describe, because we have never made either, and suppose that none of our friends will desire to try, because they may buy them much better and at a cheaper rate than they can be made; as the metal, which is a fine kind of pewter, is difficult to purchase, each pipe-maker having his own receipt; and because each pipe requires a wooden former to shape it upon, and much care in the soldering. As to the reed pipes, they are still more difficult to manufacture, and are apt to get out of tune. If the pipes are widened at the top, as in fig. S, they become trumpet stops; if narrowed upwards, as in fig. R, they utter a very soft sound, like that of the German flute. Fig. S shows the internal appearance of a reed stop, as it does also the trumpet pipe. This internal structure is exactly like that of a child's penny trumpet, with the addition of a wire which presses against the vibrating reed or metal tongue. An organ of five stops should have the following:—open diapason, stop diapason, principal, twelfth, and flute.

The length of the various pipes, and those peculiar to the different stops, we are not acquainted with, except as explained in page 316, Vol. II. If any one with a better knowledge of the subject will favor us with a practical paper upon these matters, we shall be happy to insert it.

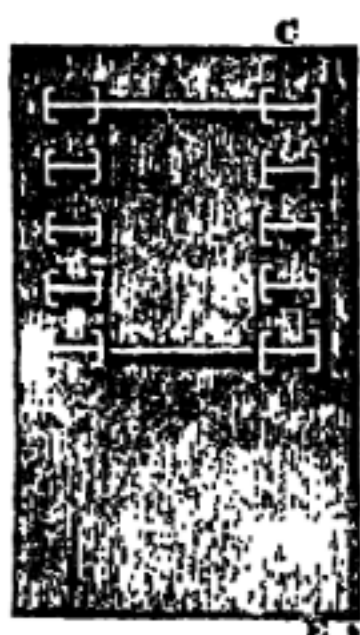
THE PRINTING PRESS.

(Resumed from page 389.)

The Coffin, Plank, and Cramps.—The plank of the coffin is now invariably made of mahogany, 3 feet long, 2 feet wide, and 1½ inch thick, on which is fastened the cramps and the coffin. The coffin is a square frame, 2 feet 7 inches long, 2 feet wide, and 3 inches deep; in this the stone is bedded. Upon each of the four corners of the coffin an iron plate, called a corner iron, is let in and screwed perfectly level with the wood work, with return sides about 6 inches long on each side, ½ of an inch thick, and 2½ inches broad. Upon each of the four corners of the coffin an iron plate, called a corner iron, is let in and screwed perfectly level with the wood work, with return sides about 6 inches long on each side, ½ of an inch thick, and 2 inches and ½ broad. Upon the upper outer sides of each of these plates another strong iron is fastened with two or three rivets through each side. This iron is ½ an inch deep; the outer angles only are square, but the inner angles are obtuse, being sloped away from the inner angle towards the farther end of each inner side, for the purpose of securing the chase with quoins. At the hinder end of the frame of the coffin, two iron joints are fastened by means of an iron plate, screw and nut, to receive the tympan which have also two half-joints to match. These keep the tympan perfectly steady, without which it would be impossible to keep in register.



Back View.



Length of the coffin, from A to B	2 ft 7 in.
Width, from A to D	2 0
Projection of the plank beyond the coffin, B to C ..	0 11
The distance of the cramps, from A to B	0 5
A to C	0 3
D to E	1 3

The Press Stone.—Marble stones are the best; and could the bedding of them in the coffin be always depended on, they would turn out to be the cheapest. Purbeck being much cheaper than marble is now generally used. The stone should be of an equal thickness, about ¼ of an inch less than the depth of the inside of the coffin, as the bedding will raise it the necessary height above the surface of the coffin. Its length and breadth must be ¼ of an inch less than the length and breadth of the inside of the coffin, to admit of justifiers between the stone and coffin, which are put in to keep the stone steady after it is bedded. The face should be perfectly smooth and level.

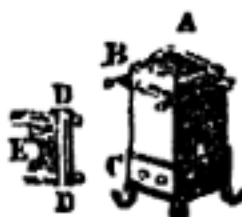
The Spindle.—The worm of the spindle should be made with such declivity, that it might come down at an assigned progress of the bar. In a whole revolution of the spindle in the nut, the toe ought to come down 2½ inches; out it seldom, at work, makes more than one quarter of a revolution

at one pull; in which sweep it comes down but ¼ of an inch. The length of the worm is 5 inches; and its circumference, 7½ inches. The whole length of the spindle is 21 inches. The bottom of the spindle is called the toe, which is about ¼ of an inch in diameter, made of well-tempered steel, that by long or careless use the points of pressure wear not on one side, but remain in the axis of the spindle.



The length of the worm, from A to B....	5 in.
B to C	3½
The distance across, from a	3
C to D	1½
E to the toe	11

The Hose, Garter, and Hose Hooks.—The hose is composed of a long, square box, or block of wood, through which is turned a hollow cone, fitting the conical or tapering part of the spindle. The spindle is held firmly in this cavity of the hose, by the following arrangement: to the inner face of the piece D D, and the corresponding pieces on the other side of the hose, are fixed curved pieces, as shown at E in the small figure. This is called the half-moon garter, and is used to hold the spindle by the groove E, (see figure of spindle) by tightening the screws, shown in the figure of the hose. The hose is cased with thin sheet iron on every side, from the piece D D, downwards; and the hooks shown at C, in the figure, are fixed to the lower end by nuts and screws.



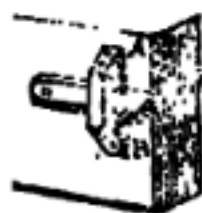
The side from A to B	4½ in.
The height, from B to C ..	10

Bar and Handle.—The bar is made of wrought iron, of about 3 feet long, and its greatest thickness in circumference, 5 inches, except the shoulder. The square pin, about 1½ inch thick, and 3 inches long, from the shoulder, enters the eye of the spindle, which it should be made to fit with a great degree of nicety. At the end of this pin an eye is made, through which an iron key is put to fasten it perfectly tight to the spindle. The wooden handle is 20 inches long, and, in the thickest part, 10 inches in circumference. A taper hole is made through the handle, into which the small part of the bar enters, and is fastened by a screw at the end of the handle. About 4 inches from the shoulder it is bent, agreeable to the sketch beneath, which lies ready to the pressman's hand, that he may catch at it to draw the handle of the bar within his reach.



A to B....	0 ft 4 in.	C to D.....	1 ft 4 in.
B to C....	1 5	E, (the handle) the same length.	

Catch for the Bar.—The catch for the bar is made of two pieces of beech, in the form of a cross. The short piece is 8½ inches long, and 2 inches wide, bevelled at each end, and in the centre of the side which is screwed against the cheek, a piece is cut out, about 2 inches long, and ½ an inch deep, to admit the other piece of 10 inches long, tapered off to the end on which the bar rests. This cross is screwed against the cheek, and fixed in such a position, as to retain the bar on its rebounding from the form.

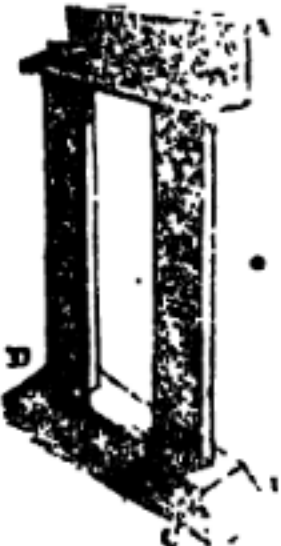


Length of the piece A B....	8½ inches,
Length of the catch D C	10

Spit and Wheel.—The axis, or spit, is a straight bar of iron, about $\frac{3}{4}$ of an inch square, and is about 3 inches longer than the whole breadth of the carriage. The further end of it is filed to a round pin, $\frac{3}{4}$ of an inch long, and $\frac{3}{4}$ of an inch in diameter; the near end is filed away to another round pin, but is $2\frac{1}{2}$ inches long. At $1\frac{1}{2}$ inch from this end is filed a square pin, $\frac{3}{4}$ of an inch long; and within $\frac{1}{2}$ an inch of the end is another round pin, with a screw and nut on it. On the square pin is fitted a winch, on which is placed the source, 5 inches long. The round ends of the spit are hung upon two iron sockets, fastened with screws on the outside of the two outer rails of the carriage. The wheel, or girth barrel, is made of beech, of such a length that it may play easily between the ribs; and of such diameter, that in one revolution a length of girth may wind about equal to half the length contained between the fore-end of the inner tympan, and the inside of the rail of the inner tympan.



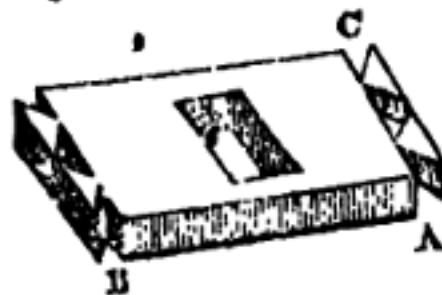
A to B	1 ft. 0 in.
Length of the wheel or barrel, B to C ..	1 2
Diameter of ditto	0 5
C to D	0 11
Length of the handle	0 5



The Fore-stay.—The fore-stay is made of four pieces of wood, mortised together for the purpose of supporting the end of the carriage, to which it is screwed by means of two inch-screws, of about 5 inches long, with nuts.

Height, from A to B ..	2 ft. 5 in.
Width, from C to D ..	1 8

The Till, or Shelf.—The till is made of mahogany, 1 foot 11 inches long, 9 inches wide, and 2 inches thick. It has two dovetail-tenons at each end, about $\frac{1}{4}$ inch long, 1 inch broad, and $1\frac{1}{2}$ inch distant from each other: these tenons are laid in the mortises in the cheeks. In the middle of the till, a square hole



Length, from A to B	1 ft. 11 in.
A to C	0 9
The square for the hose	0 4

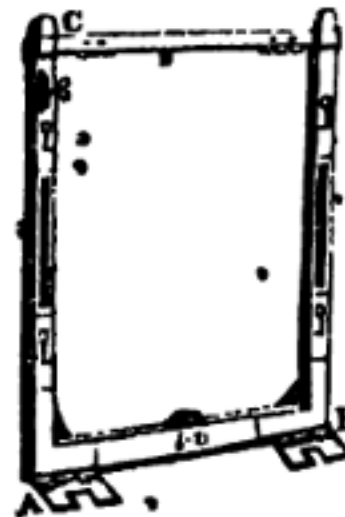
The Platin.—The platin is made of mahogany, 1 foot 7 inches long, 13 inches wide, and $\frac{1}{2}$ inches thick. The face of the platin must be perfectly level and smooth. Near the four corners, on the upper side, four iron hooks are placed, with their shanks wormed and screwed, and leaning towards the platin plate. In the centre of the platin, the iron platin plate is let in $\frac{1}{4}$ of an inch deep. This plate is 8 inches long, 4 inches broad, and $\frac{1}{2}$ of an inch thick. In the middle of it an iron frame, 2 inches square and $\frac{1}{2}$ an inch high, is placed to receive

the stud of the circular brass platin pan. The stud is made to fit nicely into the iron frame, which keeps the pan firm and steady, and may be taken out with ease if required. In the middle of the bottom of the pan is a small steel centre hole, in which the toe of the spindle works.



Length, from A to B	1 ft. 7 in.
B to C	1 1
C to D	0 4

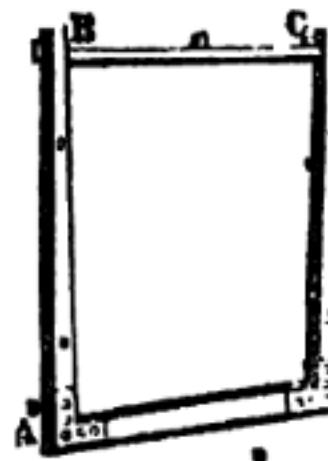
The Outer Tympan.—The outer tympan is a square frame, both sides and one end of which are made of beech, and the other end of iron. It is 2 feet wide, and 2 feet 7 inches long. The breadth of the end, which is fastened to the coffin by an iron match joint pinned on to another half joint, $1\frac{1}{2}$ inch wide, and 1 inch deep; the two sides run taper from this to the iron end, which is about the thickness of a window casement, and $\frac{1}{2}$ an inch wide. Upon the outer edge of this iron, about $1\frac{1}{2}$ inch from the end of it, are



made two iron half joints, to contain a pin, about $\frac{3}{4}$ of an inch in circumference, which entering this half joint and the match joint in the frisket, fastens it securely, and enables it to work easily on the tympan. In the middle of each side of the tympan, a mortise is made through, $\frac{1}{4}$ an inch wide, and 6 inches long, to receive the square shanks of the point screws, and to allow them to slide easily backward and forward.

The length, from A to C	2 ft. 7 in.
A to B	2 0

The Inner Tympan.—The inner tympan is also a square frame, 1 foot 10 inches wide, and 2 feet 6 inches long, the sides and one end of which are also made of wood, and the other end of iron. It is made so much shorter than the outer tympan, that the outer edge of the iron of the inner tympan may



be within the edge of the iron of the outer tympan; and is made so much narrower than the inside of the outer tympan, that a convenient space may be allowed to paste a vellum between the inside of the outer tympan and the outside of the inner tympan. The two tympanes are fastened by hooks fixed on the outer tympan, and eyes on the inner.

The length, from A to B	2 ft. 6 in.
B to C	1 10

Gallows.—On the hind part of the plank, at 3 inches distant from each side, are nailed the sockets to receive the gallows, on which the tympanes rest. The width of the gallows is 2 feet, its height 9 inches. The sockets are 7 inches long, $2\frac{1}{2}$ inches wide, and $2\frac{1}{2}$ deep. The socket-holes are cut slanting, on which the gallows reclines. The sockets are screwed or nailed down on the plank, and may be easily moved backward or forwards, to raise or lower the tympan, agreeable to the wish of the pressman. In the space on the plank, between

the sockets, one of the girths is fastened on with

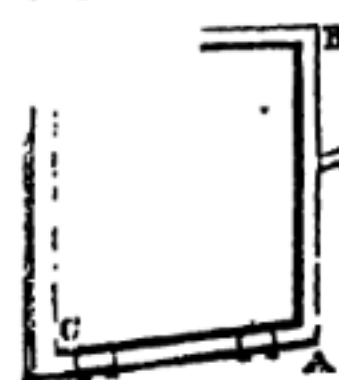


a thumb screw, which answers the purpose much better than nails, as they injure, and frequently split the plank.

Points and Screws.—Points are made of sheet iron, of different lengths about $\frac{1}{8}$ part of an inch thick, and in shape agreeable to the accompanying cut. The spur of the point is rivetted at the small end, and projects about $\frac{3}{4}$ of an inch; the top of it is filed away to a fine point. The large end of the point fits into the square shank of the point screws. These screws are

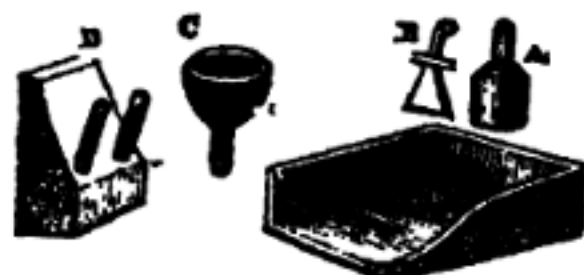


made of iron, with a thin head, about an inch square, and a square shank just under the head, 1 inch deep and $\frac{1}{2}$ an inch square. Under this shank a screw is made, with a nut and washer, which, when put through the inner tympan, draws the head of the shank close down to the tympan, and by that means secures the point in its proper place on the outer tympan.



The Frisket.—The frisket is a thin iron frame, made of different sizes, with match joints at one end, through which an iron pin is placed. About the middle of the near side of the frisket, a small piece of iron projects, called the ear, or thumb piece. Length, from A to B .. 2 ft. 2½ in. A to C 1 9

The Ink-block, Brayer and Slice, Ball Stocks, and Ball Racks.—The ink-block is made of beech, the bottom of it 2 inches, and the sides $\frac{3}{4}$ of an inch thick; its length 13 inches, the depth 4 inches, and width 9 inches. The block is fastened to the near upper rail and hind post; and the left hand outer corner of it is cut away. The brayer (A) is also made of beech, and turned round on its sides, and flat on the bottom; its length, including the handle, is about 7 inches long, and the bottom part about 2½ inches in diameter. The slice (B) is a small iron shovel, the broadest part about 4 inches, and about $\frac{1}{4}$ of an inch thick. Its length, including the handle, is 8 inches long. The ball stocks (C) are made of dry, well-seasoned elm, and turned hollow, of a conical form; their greatest diameter 5½ inches, and their length 4 inches. The handle of the stock is made of beech, 4½ inches long, and 1 inch in diameter. The racks (D) are also made of elm and beech, the sockets of which are elm, and the pins beech. The sockets of the first rack, which is nailed on the near cheek, 2 feet 9½ inches from the bottom, is 9 inches wide, and 4½ long; that end of it which receives the pins is 1½ inch thick, the opposite end only $\frac{1}{2}$ an inch thick. The pins are 9 inches long, and distant from each other 3 inches.



(To be continued.)

THE PLANE TABLE.

An instrument by which the draught or plan of an estate may be taken on the spot, while the survey or measuring is going on. It consists of a perfectly flat rectangular board, sufficiently large for the purpose, the centre of which moves freely on a ball and socket attached to the top of three legs, on which the instrument stands; by this means, when the legs are fixed in the ground, the table may be inclined or moved round in any proposed direction. For the purpose of fixing a sheet of paper on the table, there is a frame of wood, which fits exactly round its edges; one side of this frame is graduated into equal parts, and the other side into degrees from the centre of the table; by which means this instrument is made to answer the purpose of a theodolite. To the side of the table is screwed a magnetic needle and compass, to take directions and bearings; and lastly, there is a brass two-foot scale, furnished with two open sights, or else a small telescope, serving as an index. The use of the plane-table is as follows:—Having moistened a sheet of writing or drawing paper, spread it flat on the table, and secure it in this position by pressing down the frame on its edges. When this paper is dry it will be perfectly smooth, and ready to have drawn on it the plan of the proposed scene. We then begin by setting up the table at any part of the ground that is judged most proper; and having done this, a point is made in some convenient part of the paper to represent the spot where the instrument stands; we are then to fix in that point of the paper, on a leg of the compasses, or a fine steel pin, and apply it to the fiducial edge of the index, moving it round the table close to the pin till some desired point or remarkable object, such as the corner of a field, a tree, a picket, &c. be seen through the sights; from the station point an obscure line is then to be drawn along the fiducial edge of the index. We then turn the index to another object, and draw a line on the paper towards it. The same process is repeated till as many objects are set as may be deemed necessary for the purpose. We then measure from our station to each of these objects, taking the necessary offsets to corners and bendings in the edges, &c., laying down the measured distances, taken from a proper scale, upon the respective lines on the paper. The table is then to be removed to any one of the objects to which the measuring was made, as a second station. Here it must be fixed in its original position, turning it about the centre for that purpose, both till the magnetic needle points to the same degree of the compass as at first, and also by laying the fiducial edge of the index along the line between the two stations, and turning the table till the former station can be seen through the sights on the index; it is to be fixed in that position. From this new station repeat the former operations, setting several objects by the edge of the index, and measuring and laying off the distances. In this manner we proceed from one station to another, measuring such lines only as are indispensable, and determining as many as possible by intersecting lines of direction, drawn from different stations. If, before the survey be completed, the paper be full of lines, measurements, &c., recourse must be had to another sheet of paper. Draw a line in any manner through the farthest point of the last station line to which the work can be conveniently laid down; then remove the sheet from the table, and fix a perfectly clean sheet in its place, drawing upon it, in a part the most convenient

for the rest of the work, a line to represent that drawn at the end of the work on the former sheet. Cut or fold the old sheet by this line, and apply the edge so that it may exactly coincide with the corresponding line on the new sheet. While they lie together in this position, produce the last station line of the old sheet upon the new one, and place upon it the remainder of the measurement of that line, beginning where the work ended on the old. In this manner the process may be continued from one sheet to another, till the proposed survey is complete. When the survey is finished, the sheets are all to be fastened together, taking care that the lines in one sheet accurately meet the corresponding lines in another throughout.

ON LATENT LIGHT

BY PROFESSOR MOSER.

(Abridged from *Poggendorff's Annalen*.

(Resumed from page 380, and concluded.)

It is now possible to determine the latent color of some vapors, and I will first direct my attention to that of mercury. Its latent color is not blue or violet, for these colors level the images that are in the Daguerrian state, while the vapors of mercury render them visible. It may be said that it is very fortunate for the science of Daguerreotype, that this vapor does not possess blue light, for in this way it would not be possible with the visible rays of light. From what has been said above, it is also quite evident that the latent color of this vapor cannot be white. Moreover it cannot be red; for if an iodized plate be allowed to remain only a short time in the camera obscura, no image is produced on it by means of mercurial vapors, although red glass soon renders it apparent. I will only mention one of the numerous experiments that I made on this point; on a day when the time necessary for the production of a good Daguerrian image was ten minutes, I placed the plate of silver in the apparatus for only half a minute to one minute, and on covering it with a red glass I afterwards obtained a perfect negative image. I then exposed it to the action of light in the camera obscura for one, two, and three minutes, and afterwards treated it with mercurial vapors, but then no picture was produced. A similar plate was allowed to remain for three days over mercury, which was several times heated to 60° R. and upwards, and yet only a uniform layer of condensed mercurial vapor was produced, and no trace of an image.

The color of the latent light of the vapors of mercury is yellow; all phenomena with which I am acquainted agree with this supposition. In that state of the image on iodide of silver in which it can be destroyed by yellow rays, the vapors of mercury cause its appearance; but in the earlier stages the image produced by ordinary light is "levelled" both by the yellow rays and the vapors of mercury. Yellow light very easily produces blackening, and the same is the case with the mercurial vapors; and indeed it appears as if the usual gray or brownish tint of Daguerrian pictures, particularly when exhibiting much detail, depends upon a partial blackening caused by the mercury. Just as yellow light most easily converts the negative image, as obtained in the camera obscura, into a positive one, so also the vapors of mercury easily invert the image, if allowed to act for a longer period, or employed of a greater tension, as I have already shown in my former treatise. Yellow light produces the meta-

morphosis by blackening the unaffected iodide, and by decolorizing that which has been already blackened. Vapors of mercury exert a similar action on the parts not affected, which represent the shaded portions of the object; it here commences its action, becomes on these parts more strongly condensed, and consequently alters the appearance of the picture. The latter remains unaltered for several days if suspended over mercury occasionally warmed, a fact of which I have lately convinced myself. According to this we must modify the opinion which I expressed in my former treatise, viz. that on contiguous action the mercury disappeared from those parts where it had at first been condensed.

When yellow light inverts a negative image, a moment must arrive when no image whatever can be distinguished on the plate, and afterwards a positive one is formed. If we now remove the plate from the action of yellow light and expose it to the vapors of mercury, a positive image is produced, which cannot be distinguished from that formed by the yellow glasses. The quantity of mercurial vapors which is precipitated on the plate in one kind of this experiment, is too inconsiderable to produce any perceptible difference in the two images.

Moreover, the behaviour of the vapor of mercury towards the luminous effects produced by the invisible rays, is as characteristic as it is conclusive of its latent color. It never destroys an image produced by these rays, but it often produces it by very continuous action, as I have stated in my former treatise; the vapors of mercury produce the image with rapidity only when the invisible rays have acted for a long time. The true reason of this was not at that time very clear, now it is quite evident, for the same is the case with the yellow rays. It does not destroy an image produced on iodide of silver by invisible rays; but a long time is required even in the sun before an image in its earlier stages makes its appearance; and even then we usually see only traces of the picture, as already stated, probably because yellow and red glasses transmit a large quantity of heat, by which the iodide is altered and the experiment disturbed.

The color of the latent light of the vapor of iodine is either blue or violet; for this vapor levels every image in the Daguerrian stage without fail, and even a partially-developed negative one; consequently this vapor does not contain either red, green, or yellow light in a latent state, but behaves just like blue or violet glasses. When however the negative image is strongly formed, as for instance, by allowing the iodized plate to remain ten hours in the camera obscura, then the vapor of iodine is not capable of levelling it even by the most continuous action. The image is always visible, notwithstanding the manifold colors which are produced.

While on the one hand the vapors of iodine easily and completely destroy images produced by ordinary rays of light, they bring out those formed by the invisible rays just as well as blue or violet glasses, and in this respect may be very advantageously employed. I placed an engraved brass plate, an iron body, a small plate of silver, and a ring of black horn upon an iodized sheet of silver, and allowed them to remain there for several hours. The plate afterwards exhibited nothing whatever, but on being exposed to vapors of iodine until the iodide acquired a blue color, the images became plainly visible, and when placed under a blue glass were developed with all their finer details. If we consider the nature of these vapors, we must

conclude that the iodizing the silver plates does not under all circumstances increase their sensibility. It is true, that if we operate with ordinary rays, as in a camera obscura, it is then very necessary to iodize the silver, whereby it is exposed to the action of the blue or violet light which is being set free. But this operation cannot be of any service when we employ invisible rays; it must in this case be as much a matter of indifference whether the plate be previously iodized, as it is in ordinary experiments whether the iodized plate be exposed to yellow or red light before being introduced into the camera obscura. It may at first appear somewhat singular to allow the light to act first on the pure silver and then the iodine, in order to obtain a visible image; but the idea proceeds from the nature of the invisible rays and of the vapor of iodine, and it is confirmed by experiment. Bodies of brass, silver, horn, glass, &c. were laid upon a plate of pure silver only for two minutes. On introducing it into the vapors of iodine the images became visible although only weak; they became much stronger and better defined under blue glass or in daylight. I have had occasion to make many similar experiments, and have convinced myself, that as far as regards the invisible rays, iodized silver possesses no advantages over the pure metal. The only circumstance which can render the iodizing desirable is, that after the plates have been polished, they may be covered with a very uniform coating of iodide.

With regard to those of chlorine, bromine, chloride and bromide of iodine, they cannot be very if at all different from that of the vapors of iodine. These vapors possess the same general properties as iodine; and if the refrangibility of their latent light is different, the variations can only be such as cannot for the present be further examined.

The vapors of water behave precisely like those of iodine in all experiments with which I am acquainted; where one is capable of destroying an image, the other does so likewise, where one can produce an image it is also rendered visible by the other. Every image which is still in the Daguerrian state is destroyed by the vapors of water, and if it be breathed on after being removed from the camera obscura, or exposed to the vapors of warm water, it is so completely destroyed that vapors of mercury do not render it again visible. If, however, the invisible rays have produced an image on any substance whatever, the vapors of water do not destroy it; on the contrary, they make it appear. If it is very faint at first, repeated breathing on it often renders it more defined.

Suppose an iodized silver plate which has received an image which, however, is not yet outwardly visible. If the image was produced in the camera obscura, or, speaking generally, by ordinary light, when exposed to the vapors of iodine, water, or to the action of blue glass, it not only does not appear, but is "levelled" and destroyed. If, on the contrary, it was formed by the invisible rays, it is rendered visible by the vapors of iodine or water, and by the blue glass.

If, from this similarity in the action of the vapors of iodine and water and blue and violet glass, any one should be inclined to conclude that the vapors of water contain blue or violet light in a combined state, which is set free during the act of condensation, I must remark that the following circumstances are to be considered:—

1. That as yet I have discovered no difference between blue and undecomposed (white) light.

2. That the research has not yet been carried far enough to enable us to distinguish between rays of nearly the same refrangibility, as for instance between blue, violet, and dark (not invisible) light.

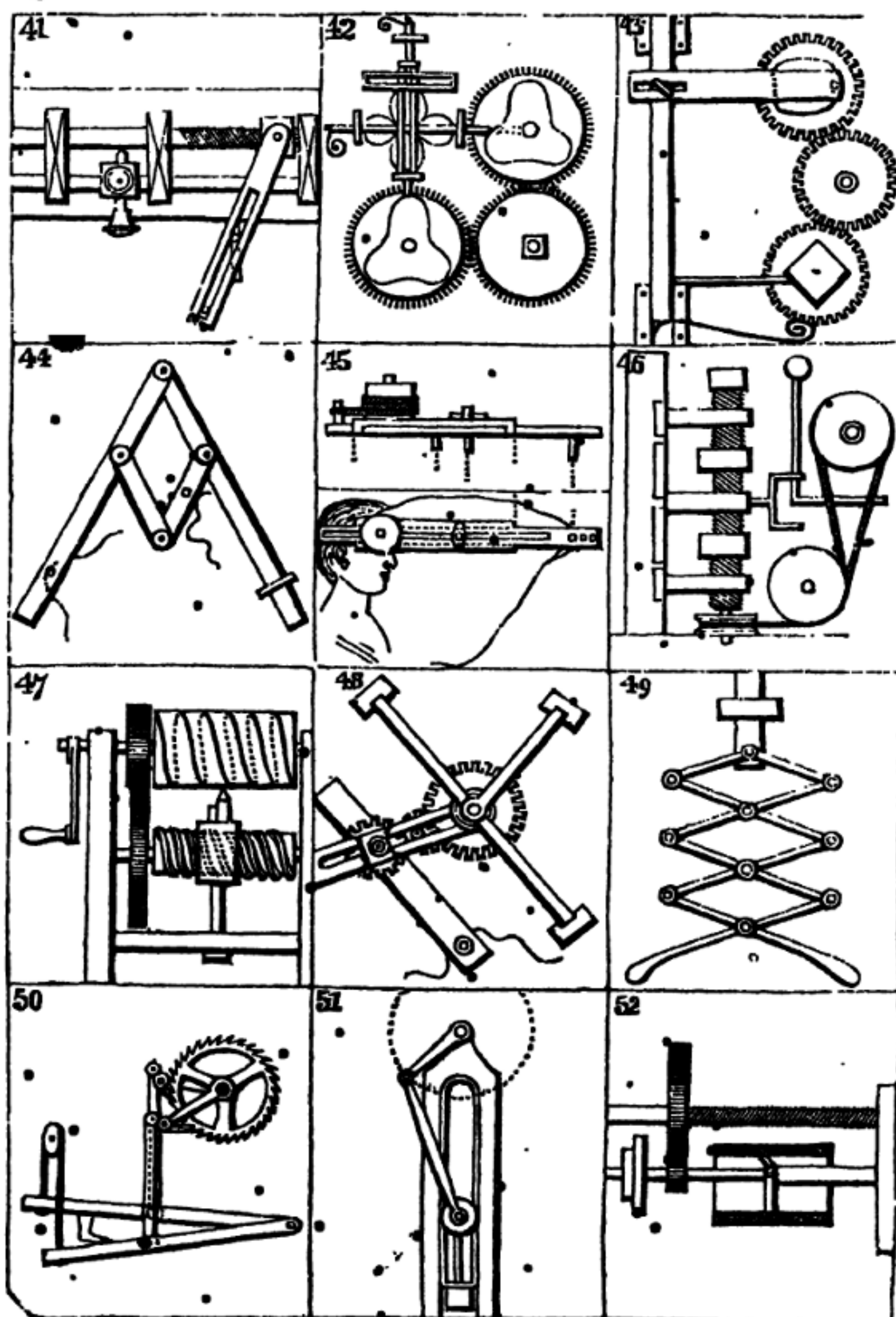
WORKING OF PEARL SHELL.

THE nacreous shells, (thus named from *nacre*, the French for mother-of-pearl,) are most commonly known in the shells of the pearl-bearing oyster of the Indian Seas, (*Ostræa margaritifera*), but they include the generality of the bivalve shells, as the various oysters, muscles, &c.; within they are smooth and iridescent, without they have a rough coat or epidermis.

These kinds contain a larger proportion of animal matter, which is considered to be arranged in alternate layers with the carbonate of lime; and as these shells also are impenetrable to water, they neither shrink nor swell. The pearl shells are less frangible and hard than the porcelaneous shells, and they admit of being sawn, scraped, and filed, with ordinary tools; but they are harsh, scratchy, and disagreeable under the operation.

The beautiful iridescent appearance of the pearl shells is attributed to their laminated structure, which disposes their surfaces in minute furrows, that decompose and reflect the light; and owing to this lamellar structure, they also admit of being split into leaves for the handles of knives, counters, the purposes of inlaying, &c.; but they are very apt to follow, and even to exceed the curvature of the surface, and therefore splitting is not much resorted to, but the different parts of the shell are selected to suit the several purposes as nearly as possible; and the excess of thickness is removed upon the grindstone in preference to risking the loss of both parts in the attempt to split them.

The usual course in preparing the rough pearl shell for the arts is to cut out the square and angular pieces with the ordinary brass-back saw, and the circular pieces, such as those for buttons, &c., with the annular or crown saw, fixed upon a lathe mandrel. The sides of the pieces are then ground flat upon a wet grindstone, the edge of which is turned with several grooves, as the ridges are considered to cut more quickly than the entire surface, from becoming less clogged with the particles ground off. The pieces are finished upon the flat side of the stone, and are then ready for inlaying, engraving, polishing, &c., according to the purposes for which they are intended. Cylindrical pieces are cut out of the thick part of the shell, near the joint or hinge, and they are rounded upon the grindstone, ready for the lathe, in which they may be turned with the ordinary tools used for ivory and the hard woods. The following are considered by an experienced dealer to be the respective qualities of the pearl shells. The Chinese, from Manilla, are the best; they are fine, large, and very brilliant, with yellow edges. Singapore, fine large shells, dead-white. Bombay, a common article. Valparaiso, also common, with jet black edges. South Sea pearl shells, common, with white edges. The very beautiful dark-green pearl shells are known as ear-shells, or sea-ears; they are unlike the others in form, being more concave, and with small holes around the margin, and are the coverings of the Halotis, found in the Californian, South-African, and East-Indian Seas. Cameos are cut in the conch-shell, *Strombus Gigas*.



MECHANICAL CONTRIVANCES.

MECHANICAL CONTRIVANCES.

(Resumed from page 363, and concluded.)

Fig. 41, is an arrangement by which spiral lines may be described upon a revolving cylinder. In this figure the square nut which is upon the horizontal screw traverses backwards and forwards, by means of the long arm attached to it, and the amount of such traverse is regulated by the pin which works in the slot beneath. The pointer is a fixture, and may be either a pencil or a cutting tool, as required. The cylinder over the pointer is that which receives the spiral marks or cuts, and is attached to the horizontal screw by a chuck, coupling box, or any other contrivance, and is renewable at pleasure, the whole being turned round by a lathe band or winch, at any convenient distance. This may be easily contrived, so that the screw is a fixture and the pointer traverses, or they may both be made to traverse.

Fig. 42. The regular curved form towards the right in the upper part of the figure being constructed, and the three wheels being put in uniform motion by the pinion at the left, and perpendicular and horizontal lines of an equal length carried to the surface of the first and third wheel, will, on being passed over the figure, describe curved lines on the wheels. These lines may afterwards be constructed as a machine, to produce the original figure to any extent, as shown in the diagram.

Fig. 43, is a combination by which a series of concentric curved lines may be described on the square surface attached to the lower wheel, by means of a point proceeding from the upright part to the right, which is traversed by the upper wheel at the same time that the square surface is revolved by the lower.

Fig. 44, is a combination of levers, called the Pentagraph, for transferring outlines on an enlarged or reduced scale. One of the longer levers must have a fixed fulcrum, the other long lever carrying a point to be passed over the outline. It is also requisite that the fixed point, the repeating point, which is on one of the shorter levers, and the tracer, should be in a line.

Fig. 45, represents a plan and elevation of an instrument for drawing curved lines from a design. The upper figure represents an elevation of a rule, having the first and third points below attached to it, and clipt or held by a similar piece carrying the second point; this second point passes through a slot in the lower rule, which is allowed to slide freely in the clips, but drawn toward the right hand extremity by means of a spiral spring and band. Supposing the second point to be firmly fixed as a centre, and the third point to be passed over the outline of the face in the plan, a curved line will be produced; and if the centre be placed on the profile, a succession of similar curves may be produced by varying the position of the profile, all of which will be common to the centre.

Fig. 46. Supposing the upper circle to represent a section of two drums close to each other, and running in opposite directions, the endless band, which passes over the carrier pulley below, will impart motion to the horizontal warve at the lower end of the perpendicular screw, which is supported by the upper and lower arms, but carries the central piece as a moveable nut; to this nut is connected a fork which at each extreme of its traverse vibrates the weighted lever, and thereby passes the endless band from one drum to the other, and reverses the revolution of the screw.

Fig. 47, is a combination whereby spirals are produced by a screw movement. The figure will sufficiently explain itself.

Fig. 48. This is a plan of an instrument similar in its nature to those represented in figures 42 and 43, for drawing curved lines around a centre; the curves may be varied in proportion to the first and third wheel.

Fig. 49. This is commonly called the lazy tongs, and shows a machine by which rectilinear motion may be transferred.

Fig. 50, is an arrangement for producing a slow circular motion by means of the feet. As a foot rests upon each treadle, and the two treadles are united at their outer ends by a rope, which passes over a pulley; the impression of one foot upon either of them, depresses that, and lifts the contrary treadle; the treadles are connected with stiff rods to wipers or palls. The treadle rising, raises the pail, with its lever belonging to it, the extremity of this catches a tooth of the wheel; upon a contrary motion of the feet, the other treadle is raised, and the first one depressed, bringing with it the wheel.

Fig. 51, is one of the simplest of the parallel motions, as well as being one of the most compact.

Fig. 52, is a section of a cylinder, in which the cutting tool for the purpose of boring is traversed by means of the screw.

TIN AND ITS USES.

Tin has a silvery-white color, with a slight tint of yellow; it is malleable, though sparingly ductile. Common tin-foil, which is obtained by beating out the metal, is not more than $\frac{1}{1000}$ of an inch in thickness, and what is termed *white Dutch metal* is in much thinner leaves. Its specific gravity fluctuates from 7.28 to 7.6, the lightest being the purest metal. When bent it occasions a peculiar crackling noise, arising from the destruction of cohesion amongst its particles.

When a bar of tin is rapidly bent backwards and forwards several times successively, it becomes so hot that it cannot be held in the hand. When rubbed, it exhales a peculiar odour. It melts at 442° , and by exposure to heat and air is gradually converted into a protoxide.

Pure tin is commonly used for dyers' kettles; it is also sometimes employed for the bearings of locomotive carriages and other machinery. This metal is beaten into very large sheets, some of which measure 200 by 100 inches, and are about the thickness of an ordinary card; the small size foil is stated not to exceed one-thousandth of an inch in thickness. The metal is first laminated between rollers, and then spread one sheet at a time upon a large iron surface or anvil, by the direct blows of hammers with very long handles; great skill is required not to beat the sheets into holes. Tin-foil is used for silvering looking-glasses, by amalgamation with mercury. Tin-foil is also used for electrical purposes. The amalgam used for electrical machines is 7 tin, 3 zinc, and 2 mercury.

Tin is drawn into wire, which is soft and capable of being bent and unbent many times without breaking: it is moderately tenacious, and completely inelastic. Tin tube is extensively used for gas fittings and many other purposes; it has been recently introduced in an ingenious manner for the formation of very cheap vessels, for containing artists' and common colors, besides numerous other solid substances and fluids required to be hermeti-

ally sealed, with the power of abstracting small quantities when required.

Tin plate is an abbreviation of tinned iron plate: the plates of iron are scoured bright with charcoal, pickled, and immersed in a bath of melted tin covered with oil, of a mixture of oil and common resin; they come out thoroughly coated. Tinned iron wire is similarly prepared: there are several niceties in the manipulation of each of these processes which cannot be noticed in this place.

Tin is one of the most cleanly and sanitary of metals, and is largely consumed as a coating for culinary vessels, although the quantity taken up by each is exceedingly small, and which was noticed by Pliny. Tin imparts hardness, whiteness, and fusibility to many alloys, and it is the basis of different solders, pewters, Britannia metal, and other important alloys, all of which have a low power of conduction.

Pewter is principally tin; mostly lead is the only addition, and at other times copper, but antimony, zinc, &c., are used with the above. The exact proportions are unknown even to those engaged in the manufacture of pewter, as it is found to be the better mixed when it contains a considerable portion of old metal, to which new metal is added by trial. In order to regulate the quality of pewter wares, the Pewterers' Company published, in 1772, "A Table of the Assays of Metal, and of the Weights and Dimensions of the several Sorts of Pewter Wares," and they threatened with expulsion from their Guild, any who departed from the regulations given in this now scarce and disregarded pamphlet. The assay is made by casting a small button of the metal to be tried in a brass mould, which is so proportioned that the button, if pure tin, weighs exactly 182 grains, all the metals added to the tin being heavier than the latter; the buttons or assays are the heavier the less tin they contain; and at page 14 of the pamphlet the following scale is given:

Assay of pure tin	182 grains.	
Ditto of fine or plate metal $1\frac{1}{2}$ grains heavier than tin, or	183 $\frac{1}{2}$ do.	*
Ditto of trifling metal $3\frac{1}{2}$ grains heavier than tin, or	185 $\frac{1}{2}$ do.	*
Ditto of ley metal $16\frac{1}{2}$ grains heavier than tin, or	198 $\frac{1}{2}$ do.	

and it may be added, although an unauthorised addition, that equal parts of tin and lead are about fifty grains heavier than tin or 232 grains.

Some of the pewters are now made nearly as common as the last: when cast they are black, shining and soft; when turned, dull and bluish. Other pewters only contain $\frac{1}{2}$ or $\frac{1}{3}$ of lead: these latter when cast are white, without gloss and hard; such are pronounced very good metal, and are but little darker than tin. The French legislature sanctions the employment of 18 per cent. of lead with 82 of tin as quite harmless in vessels for wine, vinegar, &c.

The finest pewter, frequently called "tin and temper," consists mostly of tin, with a very little copper, which makes it hard and somewhat sonorous, but the pewter becomes brown-colored when the copper is in excess. The copper is melted, and twice its weight of tin is added to it; and from about $\frac{1}{2}$ to 7 lbs. of this alloy, or "the temper," are added to each block of tin weighing from 360 to 390 lbs.

Antimony is said to harden tin, and to preserve a better and more silvery color, but appears to be

far less generally used in pewter. Zinc is employed to cleanse the metal, rather than as an ingredient: some stir the fluid pewter with a thin strip, half zinc and half tin; others allow a small lump of zinc to float on the surface of the metal whilst they are casting, with the view of lessening the oxidation.

Britannia metal, or white metal, is said to consist of $3\frac{1}{2}$ cwt. of block tin, 28 lbs. of antimony, 8 lbs. of copper, and 8 lbs. of brass: it is cast into ingots, and rolled into very thin sheets. This manufacture was introduced in about the year 1770 by Jessop and Hancock.

Tin solders are very much used in the arts, and, according to Dr. Turner—

- 1 tin, 3 lead, the coarse plumber's solder, melts at about 500 F.
- 2 tin, 1 lead, the ordinary or fine tin solder, melts at about 360 F.

COLORED SHADOWS.

In certain states of the atmosphere the shadows of opaque objects projected on a white surface are frequently observed, about the time of sunrise or sunset, to be of a blue color. This curious observation appears to have been first made by the celebrated painter Leonardo da Vinci, and is also noticed by Otto Guericke in his *Magdeburg Experiments*, but no further notice seems to have been taken of the phenomenon until about a century later, when it again occurred to Buffon. Happening to be standing on an eminence about the time of sunset, he perceived the shadows of the trees on a white wall about 30 or 40 feet distant to be colored with a light green, inclining to blue. The next morning, at sunrise, he repeated the observation; but instead of finding the shadows green, he found them blue, or rather the color of lively indigo. Afterwards he often observed the shadows both in the morning and evening, but always observed them to be blue; and he remarks that any one may see a blue shadow, if he will hold his finger before a piece of white paper at sunrise or sunset. The phenomenon has since been frequently observed; and it is usually ascribed to the aerial color of the atmosphere, which enlightens the shadows, and in which the blue rays prevail.

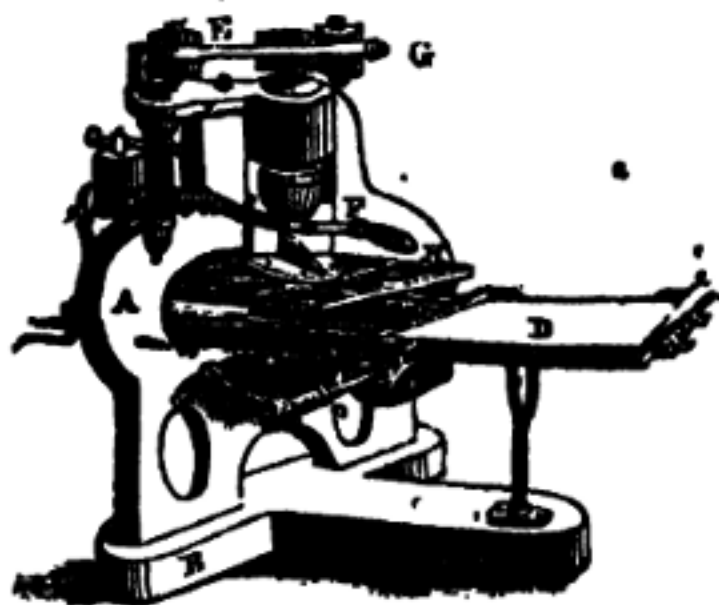
IMPRESSIONS FROM TURNED PATTERNS.

TAKE a sheet of rice-paper, paste it upon letter-paper with flour paste, which must be mixed as smooth as possible, and laid on very thin. Leave it till quite dry, then lay the rice-paper thus backed upon the piece of turning, and with the thumb nail or a piece of cloth rub the back of the paper, pressing it gently so as to make it enter into all the deep, fine cuts of the turning. The impression will be beautiful, and have the appearance of a raised medallion. It is invaluable for taking off patterns from ivory, as it can in no way injure the color or delicacy of the work; and from the facility of bending the paper, impressions can as easily be taken from round articles (as the sides of a box or pillar) as from flat ones. The medallions may be left white, or the pattern colored with water colors, leaving the ground white; and they can, besides their utility as patterns to which to refer, be employed in ornamenting various useful articles.

THE PRINTING PRESS.

(Resumed from page 298, and concluded.)

It is not our intention to teach the printing business, but to assist those who are in such circumstances that they cannot avail themselves of the assistance of others, and at the same time to explain to general readers, those instruments which are likely to interest them; thus, the necessarily long details of setting up a press, and working with it, we shall at present omit, and proceed at once to show the various improvements that have taken place, from time to time, in this valuable piece of machinery; premising, that if our country friends should desire those details which we now purposely omit, we shall be ready enough to oblige them at a future time. We proceed, then, at once to the Stanhope press, that being the next in date of invention: it is represented beneath.



What has been already said on the old wooden press will explain the uses of the various parts. A is a strong iron frame or staple; B is the foot, or as it is called from its shape the T piece; D is the table upon which the form of type is placed; E and G is the compound lever, occasioning the power F is the handle, H the platin.

This press of Earl Stanhope was invented in 1780, and is still much used, and deservedly esteemed in the improved state in which it is made at present; and although it is allowed that it does not compete with the Columbian and other presses of more modern date, yet the improvement, compared to those previously in use, must be admitted, if not in fineness of execution, at least in facility of workmanship.



In the year 1813, the ingenious Mr. Rathven, of Edinburgh, extended the principle of leverage introduced into the Stanhope press, by forming a printing press in which the action of levers was

alone employed, without the intervention of the screw, but the chief merit of his press is its great portability. Rathven's press is represented in the preceding cut.

The first peculiarity which must be noticed in this press is, that the table on which the types are placed is stationary, being fixed on the top of the frame of the press, and the platin above it is moveable on or off upon rails, in a manner similar to the carriage in the presses formerly described: the tympan and frisket, as will be seen in the figure, are attached to the frame. When the platin is drawn over the tympan, it comes into checks or catches attached to side levers, which are linked very ingeniously to the long lever, seen under the table, one end of which is affixed to a crank at the side, wrought by a winch or handle. These attachments are made in such a way, that by turning the winch motion is communicated through the levers and links to the platin, which is brought down; and in this, as in the Stanhope, the motion is at first rapid in the platin, but slow when it comes upon the tympan, so that the greatest mechanical effect is produced. Mr. Rathven's press is now chiefly used for what is called jobbing, or for impressions where the form is small.

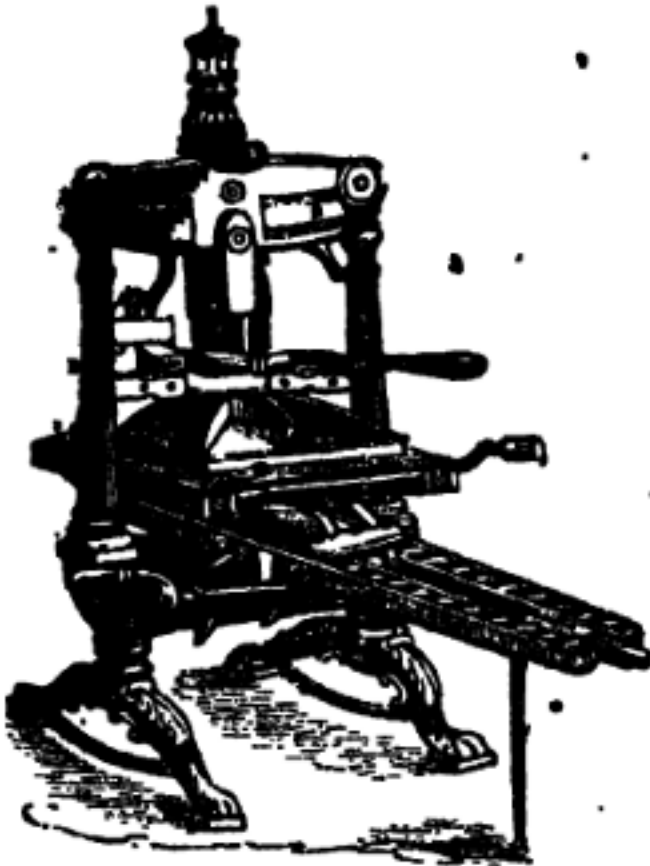
In 1814, Mr. G. Clymer, of Philadelphia, invented a printing press which has attained great celebrity. It was introduced into England in 1818, and is commonly denominated the Columbian press. In this press, as in the Rathven, the power is obtained solely by a system of levers, without the intervention either of screws or inclined planes. By this press a workman can pull a heavy form with much greater ease than with any of the presses heretofore described. Much mechanical ingenuity has been displayed in the arrangement of its several working parts, and no printing press has received so much aid in the improvement of its external appearance. A representation of the Columbian press is given in the cut below.



The checks are connected at the bottom, but not at the top. The top of the check in the right-hand side of the figure, serves as a fulcrum for one end of a large lever which is seen inclining downwards to the left. The left end of this lever is attached to a link, working in an arbor in the check, the lower end of which link is attached to another cross link, which again is wrought by the handle, or bar, seen projecting towards the bottom of the frisket. The principal lever at the top is one of the second kind, its point of action being in the

middle, where it presses down the piston of the plattin, which piston is a square rod of iron descending through guides so as to maintain the parallelism of the plattin. In order to raise the plattin when the pull has been made, a weight is placed on the top of the main lever, between the point of action in the centre and the fulcrum to the right.

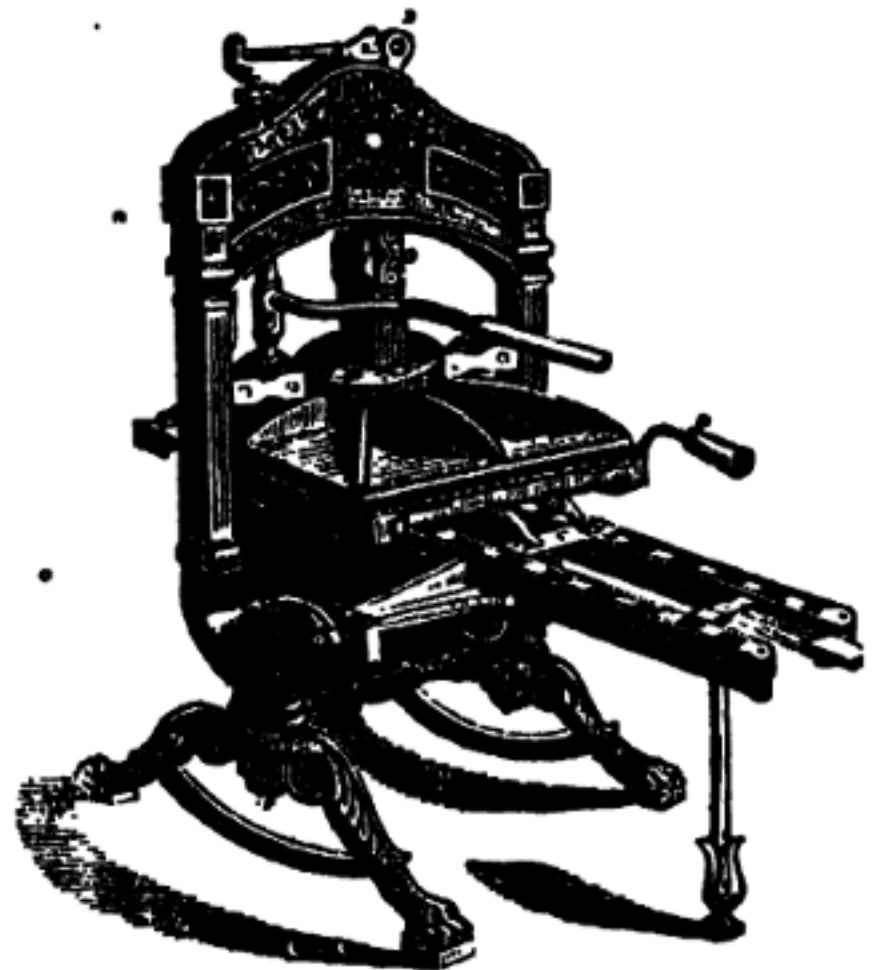
In the next cut is a view of the Albion press of Mr. R. W. Cope, which exhibits some novelties of mechanism, and has been found superior to most presses, especially for moderate-sized forms.



The pull is not heavy, and from the excellent mechanical arrangement of the working parts, the strain is so distributed as not to act very materially on any point, and hence the press of Mr. Cope is less liable than any other press, of equal power, to give way. The pressure is given by a combination of levers acted on by the bar handle, which in this press is better situated than in the Columbian, being attached to the near cheek, and consequently more within the reach of the pressman. Another great advantage connected with the bar handle, is that the pull requires only about one quarter of a turn, and consequently the impression is more speedily taken by this press than by the Columbian, and the bar handle returns only so far as to clear the rim of the tympan. The pressure is given by means of two limbs forming a knee-joint, and the action of the lever brings this knee-joint into a perpendicular position, the under link pressing down the piston which carries the plattin. The staple moves up and down in a hollow cylinder. This is the first instance in which such a contrivance has been introduced into the mechanism of a printing press. The parts are so few and so judiciously arranged, that there is little friction, or liability to wear or go wrong. The Albion press has been much improved by Mr. Hopkinson.

The Imperial press, by Sherwin and Cope, is thus described by Dr. Lardner:—"In this beautiful and compact machine, the works upon which the power depends are almost wholly concealed within the head of the press, and are in themselves extremely few and simple. The leverage connected with the bar is similar in principle to that of the Stanhope press; and the distinguishing peculiarity of this press consists in the manner in which the lever,

called the chill, is made to act upon the piston. The stout cast-iron lever or chill terminates in a sort of polished toe or point. This last-mentioned projection of the lever is made to act on a cup or knuckle acting upon the head of a stout iron bolt, which simply drops down a perforation of the piston, so as to rest upon the uppermost of two steel wedges, one of which, by its connexion with a screw in the front, admits of being pushed forward or drawn back, so as to elevate or lower the bolt, and thus regulate, by altering the length of the piston, the bearing of the plattin upon the types. The head-bolt passes through a hole perforated somewhat obliquely; by which ingenious contrivance, a side twist, which would otherwise be occasioned by the motion of the head gear, is avoided. It will now easily be perceived how, by the operation of the bar the toe is made to act upon the inside bolt, and thus force down the piston, which, after the impression has been taken, is carried back again by means of two stout steel springs attached to the insides of the cheeks of the press, and thus on the return of the bar lift the plattin from the face of the types, and allow the carriage with the form to be run out. These springs, operating uniformly, cause the action of the piston to be very smooth. The Imperial press is in high estimation for easiness in the pull, which gives it speed in working, and for evenness of impression."



OBSERVATIONS ON STONE USED FOR BUILDING.

BY C. H. SMITH, ESQ.

WHOEVER has travelled extensively in Great Britain for the purpose of examining architectural works of the present and past ages, cannot be otherwise than surprised at the remarkable difference in the condition and durability of stone. Many beautiful buildings of recent date are in a worse state of external decay, than some which have borne vicissitudes of summer and winter during six and seven centuries. To discover the causes of such decay, and the means of avoiding the evil in future, may appear to be an investigation of some difficulty, especially if we consider the immense variety of

stones used for building in this country, each composed of various elementary substances, and in very different proportional quantities; yet although we may not arrive at a perfect knowledge of the facts, some advantages may be derived from the attempt, such as suggesting inquiries, and giving interest to an important and heretofore unexplored subject, or generalising and arranging sound practical observations so as to induce others to take it up. Thus, by a series of well-directed experiments forwarded upon extensive research amidst old buildings, certain conclusions may probably be inferred, which may ultimately be established on what approaches scientific evidence.

In a long period the most refined taste in elegant architecture was extensively practised throughout this country upon scientific principles, which, if ever equalled, have assuredly never been surpassed; yet the quality of the stone employed seems rarely to have been considered further than for the facility with which it might be wrought by workmen. Relics of long-departed grandeur abound in most parts of the kingdom; nearly all the beautiful works of our ancestors are constructed with stone from the immediate neighbourhood of such buildings, apparently without any regard to color, strata, or durability, and hence we frequently see stones of very different tints indiscriminately placed together in the same elevation, some extremely perfect, others in a very mouldering condition, as in the cases of Whitby Abbey, Bristol Cathedral and King's College Chapel at Cambridge.

Caen stone was used very considerably for ornamental architecture in the south of England, from the Conquest to the time of Henry VIII; it does not seem to possess advantages over various stones of the same character, the produce of our own country; many qualities are found in the same district, and even in the same quarry, of variable durability. The central Tower of Canterbury Cathedral, St. George's Chapel at Windsor and Henry VII. Chapel at Westminster, are all built of this, about the same time, (between 1472 and 1517,) yet the Tower of Canterbury is in much better preservation than most structures of the same date, and St. George's Chapel is by no means so much dilapidated as that of Westminster, which was restored between 1808 and 1822. When political disputes probably gave rise to the prohibition of importing Caen stone, the rocks nearest the metropolis afforded the material for building, and hence *Riegate Stone*, *Gatton Stone*, *Merstham Stone* were employed, but there is hardly an instance where, having been exposed for twenty or thirty years, the surface has not mouldered into thin flakes; the greater part of Westminster Abbey was formerly built of Godstone stone. During this same period *Kentish Rag* (a hard grey limestone) was brought from the neighbourhood of Maidstone, and employed for ruder purposes; the basement of Henry VII.'s Chapel is of this material; about this time (A.D. 1600,) Portland became the general stone used for superior buildings in London, and the south of England. Inigo Jones having been deputed by James I. to survey the crown lands at Portland led to its introduction; at first all that was obtained came from thence (the locality of these lands being on the north east of the island), but as the demand increased large quantities were brought from the West and South East Cliffs, without the slightest regard to durability, quality, or any other consideration of fitness than that of meeting with an immediate sale.

Portland Stone of the most durable quality is comparatively heavy, of an uniform color, rather dark, (owing to the quantity of cement,) of a crystalline texture, regularly dispersed throughout the pores, and hence it will resist a greater force to crush it, or to disintegrate the particles. The following comparison will show the relative peculiarities of good and bad Portland stone, considering the specimens, when examined, subject in every respect to the same conditions, such as being equally wet or dry, &c.

GOOD.	BAD.
Preponderance of weight.	Deficiency of weight.
Dark colored.	Light colored.
Uniform color.	Partly colored.
Compact and crystalline.	Open and powdery.
Hard to crush.	Friable.

Glass veins as they are technically termed are no defect, they only cause the surface to wear irregularly, and when all other parts become colored by lichens or dirt, remain completely white. According to the report of Professors Daniel and Wheatstone, appended to the report on the selection of stone for building the new Houses of Parliament, the following inference may be drawn, that in all stones of the same class, the heaviest kind, or that which has the greatest specific gravity, is the most durable and best suited for architectural works. This is given as a general rule, although liable to some exceptions, but it appears to hold good with all varieties of Portland stone. The beds of Portland stone are very different in quality, the most perfect being that which is situated about midway in the series. The stratification varies in thickness from north to south; this is very conspicuous in the Way-croft quarries, where the top bed is double the thickness of the corresponding bed in the Grove quarries; the former is perhaps the best stone in the island, whereas the latter is so coarse and inferior that it is rarely or never used.

With respect to the sandstones generally it is essential to remark that as laminated strata, blocks cut from them must partake of their nature, and consequently if placed in an exposed situation with the planes of lamination parallel to the outward surface of the building, it will exfoliate or decompose in flakes, according to the thickness of the laminae, whereas if the same stone were placed so that the plane of lamination be horizontal, that is most commonly upon its natural bed, the amount of decomposition will be comparatively immaterial. Some of the sandstones are irregularly laminated, presenting an appearance across the strata of a number of short black lines, arising from small quantities of carbonaceous matter being interspersed in beds often parallel to each other, as in Craigleath bed rock, but occasionally as if formed by a succession of minute undulations, similar to rippled markings of agitated shallow water upon sand. The stone from Garscube or President quarry, near Glasgow, is of this description. Many sandstones are composed of small pebbles varying considerably in appearance, and often differing essentially in their elementary character. These are coarsely conglomerated together so as to form a sort of pudding stone or indurated gravel, of which Bramley Fall, especially the coarse grained variety, is a good example; if these various substances be exposed to the same causes of decomposition, they will resist them unequally, those parts of the stone which decompose most readily being removed, leave the durable portion exposed, so as to be more easily affected by mechanical forces, such as the freezing

and expanding of water after being absorbed by the pores of the stone, occasioning a disruption of the external particles; a constant succession of these chemical and mechanical operations will disintegrate a mass of stone, composed of various substances, in much less time than if the same bulk were formed of one uniform homogenous material, if that one material even were the most decomposable portion of the conglomerate to which allusion has just been made.

After having examined the component parts of a stone, the next consideration must be the condition of those parts to form the aggregate; in all specimens of genuine sandstone, the grains are infinitely more durable than the cement which unites them, and in some cases, notwithstanding the cement is of the best quality, it may be so scantily supplied, that the grains are scarcely attached to each other, consequently such stone must be extremely friable, and will suffer from all kinds of mechanical forces. The great portion of the mass of all sandstone is made up of quartz or siliceous grains, if the substance that cements the grains together be also siliceous, the stone will most probably be very durable; but we frequently find siliceous grains cemented with argillaceous, calcareous, ferruginous or other matters, each of which has more or less affinity for the silica, and of course the grains are more or less attached to each other. Those cements which partake most of the character of iron or clay are most likely to separate from the grains of quartz; consequently, a sandstone thus composed, will, in all probability, soon yield to atmospheric influences, because the oxygen of the atmosphere produces considerable alteration in stone containing much iron, under which circumstance it is generally reduced from a hard state to a soft and crumbling substance; if the component parts of a stone be siliceous, with a calcareous cement, there is good reason to believe that such a substance will stand the weather tolerably well, for it may be considered the natural product, of which human ingenuity has, from a very remote period, successfully formed an imitation in the commonest of all building materials, mortar.

A defect to which all sandstones are liable is, that a portion of uncrystallized, carbonaceous, ochreous or earthy powder, sometimes nearly fills the interstices between the crystals, forming occasionally what are called "clay balls," and often lying between the laminations. These are always injurious to the durability of a stone, especially if they amount to any considerable quantity. It may be remarked with respect to sandstones generally that there is seldom any difference between the numerous beds, as regards their qualities of withstanding weather; this is instanced in the Duke of Devonshire's quarries on the river Derwent, in those near Leeds, Huddersfield, Dundee, Edinburgh and Glasgow, in some of these cases being a range of 200 feet. The greatest objection to sandstones in an economic point of view is the difficulty with which they are applicable to decorative purposes, and the expense of sawing.

The *Craigleith stone*, which deserves to be classed amongst the best of sandstones, costs nearly four times as much to saw as Portland stone. It is important in many respects whether the component parts of sandstone be fine or coarse. Some kinds are composed of such large particles, as to be distinctly visible to the naked eye at several feet distance. The coarsest of *Bramley Fall*, and of other mill-stone grits from the vicinity of Leeds, are examples of this description: others are, on the contrary, so finely grained that a microscope is required

to distinguish their structure—the former would be the first to decompose in consequence; for example, among the numerous sandstone buildings in this country, those which have been constructed with a fine grained stone are usually in the best state of preservation; and it may generally be considered as a sort of rule, that the same description of work can be performed in less time if the stone be fine-grained than if it be coarse.

Particular cases may come under an architect's consideration, wherein the specific gravity of stone is of serious importance, such as landing steps occasionally under water, where there may be a rapid current, or in other situations, subject to the influence of powerful waves, especially of sea-water, such circumstances will require that a heavy stone should be used, because all bodies immersed are reduced in weight precisely equal to that of the bulk of water which they displace. The lightest stone I have ever found is from Gatton, in Surrey, weighing 103 lbs. to the cubic foot; now if a similar stone were used in water, it would be reduced 63 lbs. (the weight of a cubic foot of water;) therefore it would be like building on land with a material weighing only 40 lbs. to the foot. The heaviest building stones that have yet come under my notice are the dark grey varieties of sandstone from the vicinity of Swansea, Glamorganshire, Abercarn, Monmouthshire, the Forest of Dean, Gloucestershire, and the neighbourhood of Dundee; some of which are even heavier than granite and quite as durable, weighing upwards of 170 lbs. per cubic foot. Hence it will be perceived that such stones are peculiarly adapted for docks, harbours, breakwaters to bridges, &c. In situations constantly or alternately under sea-water, sandstone is preferable to limestone, because it is not so liable to be perforated by *Saxicava rugosa*, *Pholas*, or other boring mollusca, which frequently honeycomb calcareous stones within their reach, to the depth of several inches.

Granite ranks amongst the oldest formations; it may be considered good and durable in proportion to the fineness of the component parts, and especially in proportion to the abundance of quartz and scarcity of felspar. In Cornwall and part of Devonshire, the granite is remarkable for the superabundance of well-defined and large crystals of white felspar which it contains, and it is from this cause, that it is less durable than the granite of Aberdeen or Guernsey, in which quartz and mica preponderate greatly. The quality under all circumstances improves in proportion to the depth from which it is quarried.

THE UPAS, OR POISON TREE.

DR. DARWIN, in his *Loves of the Plants*, has given us a picture of the situation of this dreadful tree, the existence of which he seems to believe:

"Where seas of glass with gay reflections smile
Round the green coasts of Java's palmy isle,
A spacious plain extends its upland scene,
Rocks rise on rocks, and fountains gush between.
Soft breezes the breeze, eternal summers reign
And showers prolific bless the soil—in vain!
No spicy nutmeg scents the vernal gales;
No towering plantain shades the midday vales;
No grassy mantle hides the sable hills;
No flowery chaplet crowns the trickling rills;
No step retreating, on the sand impress'd,
Invites the visit of a second guest:
Pierce, in dread silence, on the blasted heath,
Fell Upas sits."

We feel it to be rather a disagreeable duty to undeceive the reader as to this fine romantic fable;

but still leaving it as the disputed property of poets and fiction mongers, we are compelled to tell the truth, and nothing but the truth. Foersch, who gave the account of the Upas, or Oopas tree of Java, in the year 1783, was a surgeon of the third class at Samarang. The falsehood of his account will be best exposed by the following abridgment of the information contained in a most valuable essay on the Oopas, or poison tree of Java, addressed to the Honorable Thomas Stamford Raffles, the lieutenant-governor, by Dr. Thomas Horsfield, which, we are assured, the reader will not consider tedious, when the interest of the subject is considered.

The author states his satisfaction in being able to give a faithful description of the tree, from personal observations made on the spot where it grows. To a person in any degree acquainted with the geography of the island, with the manners of the princes of Java, and their relation to the Dutch government at that period, or with its internal history during the last fifty years, the first glance at the account of Foersch, must have evinced its falsity and misrepresentation. But although Dr. Horsfield considers it as too contemptible to merit examination for the purpose of refuting the falsehoods Foersch has stated, in so far as relates to the situation of the poison tree, its effects on the surrounding country, and the application said to be made of the opas on criminals in different parts of the island, as well as to the description of the poisonous substance itself, and the mode of collecting it, all of which have been proved to be forgeries; yet the existence of a tree in Java, from whose sap a poison is prepared, equal in fatality, when thrown into the circulation, to the strongest animal poisons hitherto known, is a fact which Dr. Horsfield proposes to illustrate.

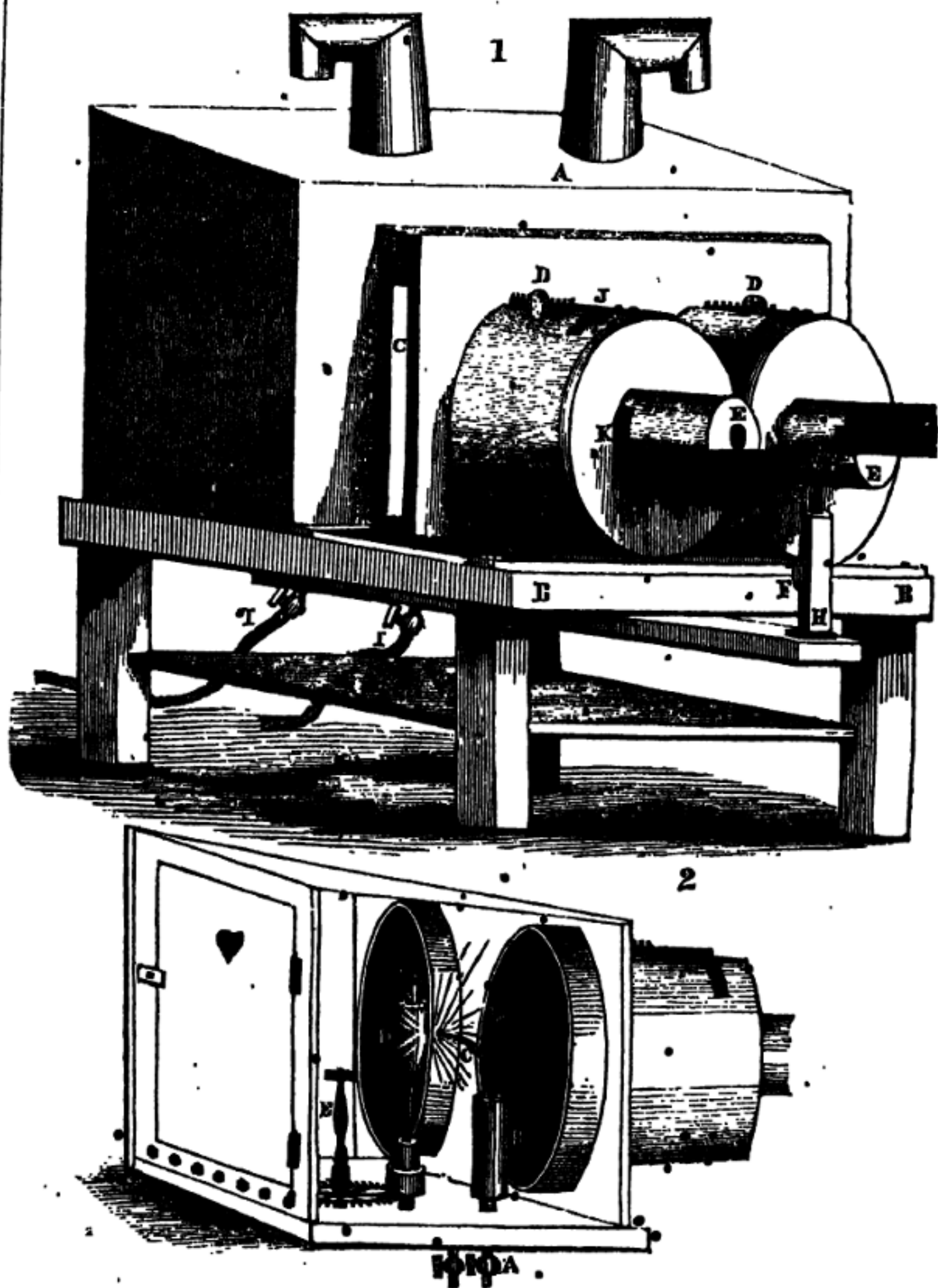
The tree which produces the poison is called *Antshar*, and grows in the eastern extremity of the island, in the district of Blambangan, and in the environs of Banjoo-wangee, as well as in various other parts of Java. The antshar belongs to the class *Monæcia* of Linnæus. The male and female flowers are produced in catkins (amentæ) on the same branch, at no great distance from each other; the female flowers are in general above the male. The characters of the genus are: Male flower—*Calyx*, consisting of several scales which are imbricate; *corolla*, none; *stamens*, filaments many, very short, covered by the scales of the receptacle-anthers. The receptacle on which the filaments are placed has a conical form, abrupt, and somewhat rounded above. Female flower—*Catkins*, ovate; *calyx*, consisting of a number of imbricate scales (generally more than in the male), containing one flower; *corolla*, none; *pistil*, germ single, ovate, erect; *styles*, two, long, slender, spreading; *stigmas*, single, acute; *seed-vessel*, an oblong tube, covered with the calyx; *seed*, an ovate nut with one cell.

The antshar is one of the largest trees in the forest of Java. The stem is cylindrical, perpendicular, and rises, completely naked, to the height of sixty, seventy, or eighty feet. Near the surface of the ground it spreads obliquely, dividing into numerous broad appendages, or wings, much like the *Canarium commune*, and several others. It is covered with a whitish bark, slightly bursting into longitudinal furrows; near the ground this bark is, in old trees, more than half an inch thick, and upon being wounded, it yields plentifully the milky juice from which the celebrated poison is prepared.

A puncture or incision being made in the tree, the juice or sap appears oozing out, of a yellowish color, somewhat frothy, from old trees; paler, and nearly white, from young ones. When exposed to the air, its surface becomes brown. The consistence very much resembles milk, only it is thicker and more viscid. This sap is contained in the true bark, or *cortex*, which yields a considerable quantity from a puncture, so that in a short time a cupful may be collected from a large tree. The inner bark, or *liber*, is of a close fibrous texture, like that of the *Morus papyrifera*, and when separated from the other bark, and cleansed from the adhering particles, resembles a coarse piece of linen. It has been worked into ropes, which are very strong, and the poorer class of people employ the inner bark of younger trees, which is more easily prepared, for the purpose of making a coarse stuff, which they wear when working in the fields. But it requires much bruising, washing, and a long immersion in water, before it can be used; and even when it appears completely purified, persons wearing this dress, on being exposed to the rain, are affected with an intolerable itching, which renders their flimsy covering almost insupportable. This deleterious quality exists in the gum, a small portion of which still adhering to the bark produces this irritating effect when it becomes wet. It is singular that this property of the bark is known to the Javanese in all parts where the tree grows, while the preparation of a mortal poison from its juice, is an exclusive art of the inhabitants of the eastern extremity of the island. One of the regents in the eastern districts ordered caps to be prepared from the inner bark of the antshar, which were stiffened in the usual manner with thick rice-water, for the purpose of decorating his *mantries*, but they all decidedly refused to wear them, asserting that it would cause their hair to fall off.

The stem of the antshar having arrived at the before-mentioned height, sends off a few stout branches, which, spreading horizontally, with several irregular curves, divide into smaller branches, and form a hemispherical, but not very regular crown. The external branches are short, have several unequal bends, and are covered with a brown bark. The leaves are alternate, oblong, heart-shaped, somewhat narrower towards the base, entire, with a waving or undulated margin, which sometimes has a few irregular sinuities. The longitudinal nerve divides the leaf somewhat obliquely, and the inferior division is generally the larger. The point is irregular, some are rounded at the end, others run up almost abruptly to a short point. The upper surface is nearly smooth, but some widely-dispersed short villi are observed on it; the inferior is slightly rough, reticulated, and marked with oblique parallel veins. The petiole is short. The flowers are produced towards the extremity of the outer branches in a few scattered catkins; the common peduncle of the males is slender and long; that of the females is shorter.

Previous to the season of flowering, about the middle of June, the tree sheds its leaves, which reappear when the male flowers have completed the office of fecundation. It delights in a fertile and not very elevated soil, and is only found in the largest forests. The greatest diameter of the antshar is at least ten feet: the wood of this tree is white, light, and of a spongy appearance.



THE DISSOLVING VIEWS.

THE DISSOLVING VIEWS.

We have been so repeatedly asked for a more particular description of the dissolving views, that we are glad to have seen the whole apparatus, and to be thereby enabled to lay the details of it before our readers. The dissolving views were first shown in England many years since by Mr. Childe at the Adelphi Theatre, though it does not appear that they were invented by him, but by a German named Philipstall. The principle upon which Mr. Childe played his lanterns was very simple, and it will be best explained by considering first how the views may be produced by the simple magic lantern without other aid. As we fully explained the nature of the magic lantern and phantasmagoria in the first volume, with the making of its screens and the painting of its glasses, it will not be necessary to enter at present into the consideration of that instrument, but we will suppose that our readers are acquainted with its structure and the manner of playing it upon ordinary occasions. A transparent screen being between the spectators and the operator ready to receive the images, and the lantern being lighted and fixed upon a table at any convenient distance behind the screen, according to the size that the pictures are required to be, we will suppose that a slider with a view upon it is placed in the lantern, by properly adjusting the focus the view will appear clear and bright upon the screen, as is well known. Now by shifting the position of the first lens, the lantern is thrown out of focus, and consequently the view becomes obscure; when at its greatest degree of obscurity, a second slider is to be slipped in over the first, and the confusion is rendered therefore more complete. When the second view is in its place, withdraw the first, and then gradually bring the lens up again to focus, when the second view will show itself clearly, as the former one did at first. This may be withdrawn, and a third substituted in the same manner. The above is only an approximation to the true dissolving views, for in altering the focus, you of necessity show some motion in the scenery, and this is to be avoided; and if the common sliders are employed, a dark line is seen across the field of view when a slider is introduced or withdrawn, on account of the end of the frame of the slider, so that all sliders for this purpose, if used with common lanterns, must be made without the end rail.

We shall now proceed to show what will be the effect of employing two lanterns; for it is with two, or in moving scenes with three, or even four lanterns, that the true and best effect is produced. In addition to the magic lantern alluded to in the last experiment, let us place beside it a second lantern of equal power and focus, and adjust both to the proper size of the field of view on the screen. Now put a slider in each, the mixture of the two will produce a mass of obscurity and confusion, but if you stand behind the lanterns, and place your hand over the nozzle of one of them, the view from the other will be clear and well defined; gradually withdraw your hand from before the lantern, and place the other hand as gradually before the nozzle of the second, and the view will evidently be altered. Mr. Childe used to have a little flap of tin in the front of each lantern, to shut off the light alternately from one to the other. This is the whole art and mystery of the dissolving views; and at the Adelaide Gallery and the Polytechnic Institution, the only reason the views are of a superior character to those we may be able to produce at home with

our own common apparatus, is that the lanterns and the sliders are of a large size, glassed with the best glasses, so as to avoid achromatic refraction, and illuminated with the brilliant light produced by the oxy-hydrogen gases thrown upon a cylinder of lime, in the same manner as we explained in treating of the oxy-hydrogen microscope in Vol. II. The following is a description of the whole apparatus used at the Polytechnic Institution, where these views are exhibited in the greatest beauty and perfection, the screen upon which they are shown presenting a surface of 618 square feet; and our readers will observe, that while the views of Mr. Childe were through a transparent screen from behind, at the Polytechnic they are thrown upon a screen, the lanterns being on the same side of the screen as the audience; not that this makes much difference in their brilliancy, but it was necessary to explain this, lest a discrepancy should be observed in the following account compared to what we have already stated:—Instead of two distinct lanterns there is employed at this Institution a single lantern with two nozzles and sets of lenses; also two lights are placed withinside.

Fig. 1, shows the outward form of the whole. A is the box; B B the table upon which it stands; C the hole into which the sliders are placed, or they may be inserted in a hole cut at K; there being a double convex lens between C and K, about opposite to the letter J. This is capable of adjustment by the thumb screws D and D'. E E is the nose of each lantern; G is a flap of tin, which being turned round, obscures and shuts off the light of one lantern, while it displays that of the other. It is made to slide up and down by means of the nut F, and is put nearer or farther from the lanterns by the sliding piece H. A peculiarity as to shutting off the light is here to be observed. There should evidently always be upon the screen as much light as is thrown by one lantern, and in shutting off the light, the upper part of one lens should be displayed, while the upper part of the other lens is obscured, otherwise in the last case at each change one part of the field of view would be darker than the other; and if the dissolver or fan did not exactly admit as much light as it obscured, the field of view would fluctuate in its brilliancy. Both these requirements are fully accomplished by the fan here shown. The arms are however moveable, because in some cases it is required to use two lanterns at once, as in several of the moving scenes, where a boat, or a bird, a mill, &c. is seen to be in motion; this is done generally speaking by the second lantern, only a little of its light being admitted; thus if a boat sailing were to be thrown across the previous view, the boat would be painted on a slider and surrounded with black, so that no more light should be allowed to pass from the lantern than passes through the lines of the boat itself, and this is too small in quantity to affect the general brilliancy. In this manner Mr. Childe produced two beautiful moving scenes, summer and winter. In the latter a snow storm was seen with great truth of delineation. The wintry view was cast from one of the lanterns; the snow was represented by making minute specks of light upon a glass painted black; this was drawn through a second lantern, not sideways as upon ordinary occasions, but drawn upwards from the bottom; and as in all these experiments the motion of objects is reversed, the snow, represented by the light passing through the white specks, appeared to fall.

Fig. 2, shows the structure of the lime light, and it will be seen to be exactly like that already ex-

pane, when considering the oxy-hydrogen microscope. At A are two pipes admitting the gases. In the receiver B they are mixed; they then pass in a mixed state through the blowpipe C, and being ignited, strike against the lime cylinder D, producing the required light. E is a key connected with a wheel, which works in a pinion beneath the lime cylinder, for the purpose of turning it round that a new surface may every now and then be presented to the flame. The distance of the lime cylinders from the condensers, or the lenses which are nearest to them is about 8 inches, and in order that the sliders may not be cracked, or the painting peeled off by the heat, a plain piece of glass is attached to the painted side of the slider. In Fig. 1, I show the position of the pipes which convey the gases.

The lime cylinders, which may be used for all purposes of this kind, are about $1\frac{1}{2}$ inch long, and $\frac{3}{4}$ inch in diameter, with a hole through them. To make them, we may procure a piece of chalk, marble or lime-stone, and cut it to a proper shape and size; put several of these in a crucible, and keep them red hot in fire for three or four hours. They should afterwards be kept in stoppered bottles till wanted for use. Those of chalk are to be preferred.

HAIR PENCILS, AND MANNER OF CHOOSING THEM.

PENCILS for painting in miniature are not made of camel's hair, but of the tips of squirrel's tails, and of these there are two kinds, the dark brown, and yellowish red. Pencils made of the latter kind are called sable pencils, and are of a stiffer nature than others. They are a useful kind of pencil, as long as the fine flue at the end of the hair remains, on account of their elasticity; but the instant the flue is worn off, they, from their harshness, become useless; at all events, no pencil can be superior to one made of the common kind of hair. The error too prevalent amongst young miniature painters, is that of preferring a very small pencil for their work, vainly hoping by the assistance of such a one, to execute their picture with more neatness and accuracy; but in this they will, by experience, find themselves mistaken; the finest and most highly-finished picture being executed with a middle-sized pencil, the point of which being not only sufficiently neat, but from its body containing a quantity of coloring fluid, enables the artist to give that mellow firm touch which is so generally admired by connoisseurs in the art. The young artist should choose a middle-sized pencil, with a good spring and point, both of which he will know by drawing the pencil lightly through his mouth, and touching it on his thumb-nail; if he finds it, on being moderately wet, to spring again into its form, after being bent, it is a good sign; but as there are many pencils possessed of that quality, which are deficient in another material one, namely, that of a good point, that must be very cautiously looked to, by turning the pencil round on the nail, in every direction, observing the hairs at the point keep equally together of a length, and none shooting out on either side (which is often occasioned by the pencil maker putting the hair into the quill with a twist in it). All these defects being carefully guarded against, you are sure of being in possession of a very principal material for miniature painting.

These remarks, although made to apply chiefly to miniature painting, are equally applicable to all methods of painting both in oil and water colors.

LOCOMOTION.

THE chief obstacles which oppose locomotion, or change of place, are gravity and friction, the last of which is, in most cases, a consequence of the first. Gravity confines all terrestrial bodies against the surface of the earth, with a force proportionate to the quantity of matter which composes them. Most kinds of mechanism, both natural and artificial, which assist locomotion, are arrangements for obviating the effects of gravity and friction. Animals that walk, obviate friction by substituting points of their bodies instead of large surfaces, and upon these points they turn, as upon centres, for the length of each step, raising themselves wholly or partly from the ground in successive arcs, instead of drawing themselves along the surface. As the feet move in separate lines, the body has also a lateral, vibratory motion. A man, in walking, puts down one foot before the other is raised, but not in running. Quadrupeds, in walking, have three feet upon the ground for most of the time; in trotting, only two. Animals which walk against gravity, as the common fly, the tree-toad, &c., support themselves by suction, using cavities on the under side of their feet, which they enlarge, at pleasure, till the pressure of the atmosphere causes them to adhere. In other respects their locomotion is effected like that of other walking animals. Birds perform the motion of flying by striking the air with the broad surface of their wings in a downward and backward direction, thus propelling the body upward and forward. After each stroke, the wings are contracted, or slightly turned, to lessen their resistance to the atmosphere, then raised, and spread anew. The downward stroke also, being more sudden than the upward, is more resisted by the atmosphere. The tail of birds serves as a rudder to direct the course upward or downward. When a bird sails in the air without moving the wings, it is done in some cases by the velocity previously acquired and an oblique direction of the wings upward; in others, by a gradual descent, with the wings slightly turned, in an oblique direction, downward. Fishes, in swimming forward, are propelled chiefly by strokes of the tail, the extremity of which being bent in an oblique position, propels the body forward and laterally at the same time. The lateral motion is corrected by the next stroke, in the opposite direction, while the forward course continues. The fins serve partly to assist in swimming, but chiefly to balance the body, and keep it upright; for the centre of gravity being nearest the back, a fish turns over, when it is dead or disabled. Some other aquatic animals, as leeches, swim with a sinuous or undulating motion of the body, in which several parts at once are made to act obliquely against the water. Serpents, in like manner, advance by means of the winding or serpentine direction which they give to their bodies, and by which a succession of oblique forces are brought to act against the ground. Sir Everard Home is of opinion that serpents use their ribs in the manner of legs, and propel the body forwards by bringing the plates on the under surface of the body to act successively, like feet against the ground. This he deduces from the anatomy of the animal, and from the movements which he perceived in suffering a large coluber to crawl over his hand. Some worms and larvae of slow motion extend a part of their body forwards, and draw up the rest to overtake it, some performing this motion in a direct line, others in curves. When land animals swim in water, they

are supported, because their whole weight, with the lungs expanded with air, is less than that of an equal bulk of water. The head, however, or a part of it, must be kept above water, to enable the animal to breathe; and to effect this, and also to make progress in the water, the limbs are exerted, in successive impulses, against the fluid. Quadrupeds and birds swim with less effort than man, because the weight of the head, which is carried above the water, is, in them, a smaller proportional part of the whole than it is in man. All animals are provided, by nature, with organs of locomotion best adapted to their structure and situation; and it is probable that no animal, man not being excepted, can exert his strength more advantageously by any other than the natural mode, in moving himself over the common surface of the ground. Thus walking cars, velocipedes, &c., although they may enable a man to increase his velocity, in favorable situations, for a short time, yet they actually require an increased expenditure of power, for the purpose of transporting the machine made use of, in addition to the weight of the body. When, however, a great additional load is to be transported with the body, a man, or animal, may derive much assistance from mechanical arrangements. For moving weights over the common ground, with its ordinary asperities and inequalities of substance and structure, no piece of inert mechanism is so favorably adapted as the wheel-carriage. It was introduced into use in very early ages. Wheels diminish friction, and also surmount obstacles or inequalities of the road, with more advantage than bodies of any other form in their place could do. The friction is diminished by transferring it from the surface of the ground to the centre of the wheel, or, rather to the place of contact between the axletree and the box of the wheel; so that it is lessened by the mechanical advantage of the lever, in the proportion which the diameter of the axletree bears to the diameter of the wheel. The rubbing surfaces, also, being kept polished, and smeared with some unctuous substance, are in the best possible condition to resist friction. In like manner, the common obstacles that present themselves in the public roads, are surmounted by a wheel with peculiar facility. As soon as the wheel strikes against a stone or similar hard body, it is converted into a lever for lifting the load over the resisting object. If an obstacle eight or ten inches in height were presented to the body of a carriage unprovided with wheels, it would stop its progress, or subject it to such violence as would endanger its safety. But by the action of the wheel, the load is lifted, and its centre of gravity passes over in the direction of an easy arc, the obstacle furnishing the fulcrum on which the lever acts. Rollers placed under a heavy body diminish the friction in a greater degree than wheels, provided they are true spheres or cylinders, without any axis on which they are constrained to move; but a cylindrical roller occasions friction, whenever its path deviates in the least from a straight line. The mechanical advantages of a wheel are proportionate to its size, and the larger it is, the more effectually does it diminish the ordinary resistances. A large wheel will surmount stones and similar obstacles better than a small one, since the arm of the lever on which the force acts is longer, and the curve described by the centre of the load is the arc of a larger circle, and, of course, the ascent is more gradual and easy. In passing over holes, ruts, or excavations, also, a large wheel sinks less than a small one, and consequently occasions

less jolting and expenditure of power. The wear also of large wheels is less than that of small ones, for if we suppose a wheel to be three feet in diameter, it will turn round twice, while one of six feet in diameter turns round once; so that its tire will come twice as often in contact with the ground, and its spokes will twice as often have to support the weight of the load. In practice, however, it is found necessary to confine the size of wheels within certain limits, partly because the materials used would make wheels of great size heavy and cumbersome, since the separate parts would necessarily be of large proportions to have the requisite strength, and partly because they would be disproportioned to the size of the animals employed in draught, and compel them to pull obliquely downwards, and therefore to expend a part of their force in acting against the ground.

OIL PRINTING IN COLORS.

ALL kinds of letter-press, copper-plate and lithographic prints are colored with oil paints, but the above term applies particularly to those in which two or more colors appear. In letter-press and copper-plate printing this has been done for a long period. With copper the system is now disused, though it will be easily understood by the explanations of the arts in lithography and letter-press. The former of which has lately been much practised in two colors, a ground with lights cut out being printed first, and the black design afterwards. Letter-press printing, in various colors, has also of late years been carried to a degree of perfection, before unknown, by Mr. G. Baxter, of Charterhouse Square, a patentee of what he has been pleased to call oil-color printing. The two processes we have alluded to are as follows:—

Printing from two or more stones with different colored inks.—This is managed by preparing a composition of two parts of wax, one of soap, and a little vermilion. Melt them in a saucepan, and cast them into sticks; this must be rubbed up with a little water to the thickness of cream, and applied to the surface of a polished stone. An impression is taken in the common way from a drawing, and applied to a stone prepared in this manner, and passed through the press, taking care to mark, by means of this impression, two points in the margin corresponding on each of the stones. The artist, having thus on the second stone an impression from the first drawing to guide him, scrapes away the parts which he wishes to remain white on the finished impression. The stone must now be etched with acid stronger than the common etching water, having one part of acid and twenty of water; the whole is then washed off with turpentine: this plan is generally used in printing a middle tint from the second stone; the black impression being given from the first stone, a flat transparent brownish tint is given from the second, and the white lights are where the paper is left untouched. The dots are necessary to regulate the placing of the paper on the corresponding parts of the two stones.

In the oil color prints of Mr. Baxter, the depth and brilliancy of an oil painting is produced by the whole of the colors being laid on and blended together by the operation of the printer's press; the ground work upon which they are laid being an engraving on metal or wood, and printed in black, neutral tint, or other color, according to the effect ultimately to be produced. For each color afterwards to be laid on, a separate wood-cut is so

prepared, that it exactly covers an appointed part of the picture, the edges of the wood-cut being left sharp, if the color is to end in an abrupt line; or hollowed out, or sloped away more or less, where the color is to be gradually softened off. The whole of the wood-blocks, (sometimes thirty in number,) being prepared, a peculiar ink, tinted with the requisite color is taken, and by means of small balls is dabbed upon the block of wood first to be used. The print, by a very nice adjustment with the points of needles, is placed upon the block, and which is already laid upon the table of a printing press, and being passed through the press, the color from the wooden block is impressed upon the print: it is then printed upon in like manner by a second block of wood; afterwards in regular order by all the rest, until the whole is complete, the picture then assuming the utmost delicacy and power. The fine painted prints of the Death of Mr. Williams, and the Coronation of Her Majesty, by this artist, show the capacity and beauty of the result of the art.

GENERAL MANAGEMENT OF GREEN-HOUSE PLANTS.

GREEN-HOUSE plants, properly so called, are plants which only require protection from frost in winter. The more air they have given them when not frosty, the more healthy they will be. On a fine morning, the sooner air is admitted the better; but it is best to shut up pretty early in the afternoon, particularly if likely to be a cold night. No fire is required, except frost is expected in the night, or the house should be damp with continued wet weather; then a little fire is requisite to dry the house, as plants are more liable to be injured by damp than by cold. The plants should be looked over most days to see if any require water, which must only be given when quite dry, in the winter season; from 9 to 12 o'clock in the morning is the best time for watering them, for if watered in the afternoon they are apt to be chilled at night, which makes their leaves look yellow and unhealthy. When the surface of the mould is green with moss, &c., the top should be taken off, and the surface moved with a flat stick, but not deep enough to disturb the roots; if a little fresh mould is wanting on any of them it should be added. Always be careful to put the same kind of soil they are already grown in, for if you put a different kind on, it injures plants more than some cultivators are aware of.

When the weather begins to get warm in spring, some air should be left all night to harden the plants before they are set out: a little must be left at first, and continue to increase it every night till they have full air, if the weather will allow of it. The time of setting them out in the open air depends entirely on the weather. Sometimes they may be put out with safety by the middle of May; in other seasons not till the latter end, but they had better stay in a little too long than be put out too soon. Calm cloudy weather is the best time for setting them out, when as sheltered a situation as possible should be chosen for them. The best time for shifting them in fresh pots is early in spring; some shift them before they are set out, and let them make fresh roots while in the green-house, which is a very good plan, particularly for young or tender plants. If any plants are too tall, and want cutting back, it should be done early in spring, as soon as they begin to grow, then they have time to recover themselves, and make good bushy plants by autumn.

Cuttings require to be put in at various seasons, and in different situations. From Christmas to May is considered the best time for cuttings in general; but some require to be put in at various seasons throughout the year, according to the state of the shoots. Most of the young plants that are potted off in spring will want shifting in larger pots in autumn. While the plants are out they must be attended regularly with water. The best time for watering them in summer is as late as possible in the afternoon; then they have all the night to refresh them. If watered in the morning of a warm day they will dry again almost immediately. Plants should not remain out too long in autumn, as they are liable to get too much wet, and the worms get in the pots. The middle of September should be the latest, but give them full air as long as the weather will permit. Seeds of green-house plants should be sown early in spring; the beginning of February is a good time, then the plants get strength before winter.

MAKING SILKWORM GUT.

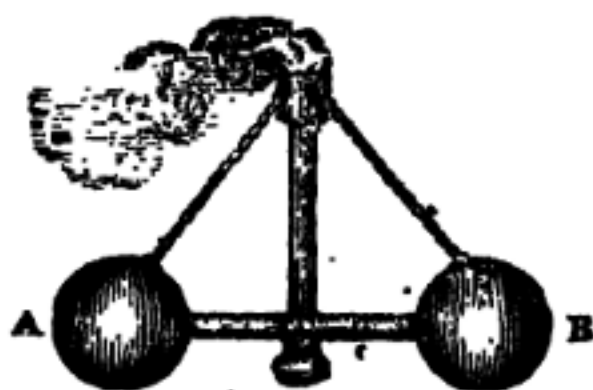
SILKWORM gut is the most esteemed article for fishing lines of any substance known. It is of extreme strength and durability, and its natural color is not found to be objectionable to fish. As its name implies, it is manufactured from the intestines of the silkworm. Take the best and largest silkworm you can procure, just when they begin to spin; this may be known by their refusing to eat, having a fine silk thread hanging from their mouths. The worms must be kept in some strong vinegar covered close over for twelve hours if the weather is warm, if not, two or three hours longer will be necessary; when taken out they must be pulled asunder, and you will see two transparent guts, of a yellow green color, as thick as a small straw, bent double, the rest of the inside resembling boiled spinach: you can make no mistake. If you find the guts soft, or break upon stretching them, you must let the worms lie longer in the vinegar: when fit to draw off, you must dip one in the vinegar, and stretch it gently with both hands to the proper length, or very nearly so. The gut thus drawn out must be stretched out on a thin piece of board, by putting each end in a slit therein, and placed in the sun to dry. This is the real gut, and the mode of drying it is the cause of the ends being always cramped. If your worms are good, and you follow this plain receipt, you may depend on having the best gut.

CHEAP COPYING MACHINE.

A VERY simple, and, at the same time, effectual, copying machine may be made as follows:—Take a roller of beech, or any hard wood, about 18 inches long, and 1 inch in diameter, and having cut a longitudinal slit therein nearly the whole length, insert in it and fasten very neatly with glue a slip of strong cloth, about 14 inches wide, and 18 inches long; the remaining part of the roller will serve as a handle, and may be cut with several faces to obtain a firmer hold. To use this copying press, lay the sheet of paper on which the letter is written upon the strip of cloth; on that place the thin copying paper, and upon these lay a thick baize, or horse-hair pad; then roll the whole round the roller, and grasping that part where the cloth is with the left hand, turn the roller round with the right, gradually increasing the grasp with the left; the pressure becomes very great, and quite sufficient to transfer the letter to the copying paper.

LIFE-BUOYS AND LIFE PRESERVERS

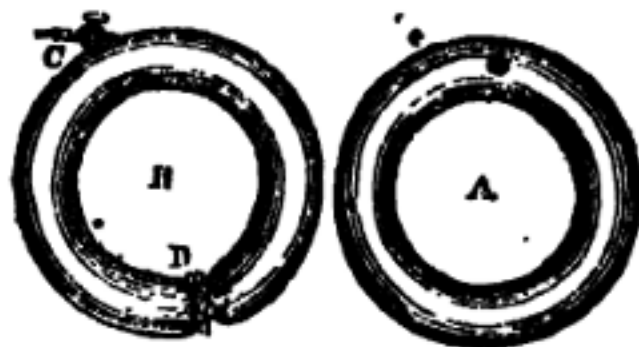
The life-buoy, now commonly used in the British navy, is the invention of Lieutenant Coots, of the royal navy. It consists of two hollow copper vessels



connected together, each about as large as an ordinary-sized pillow, and of buoyancy and capacity sufficient to support one man standing upon them. Should there be more than one person requiring support, they can lay hold of rope becketts, fitted to the buoy, and so sustain themselves. Between the two copper vessels, there stands up a hollow pole, or mast, into which is inserted from below an iron rod, whose lower extremity is loaded with lead, in such a manner that, when the buoy is let go, the iron slips down to a certain extent, lengthens the lever, and enables the lead at the end to act as ballast. By this means the mast is kept upright, and the buoy prevented from upsetting. The weight at the end of the rod is arranged so as to afford secure footing for two persons, should that number reach it; and there are, also, as was said before, large rope becketts, through which others can thrust their head and shoulders till assistance is rendered. At the top of the mast is fixed a port-fire, calculated to burn about twenty minutes, or half an hour: this is ignited, most ingeniously, by the same process which lets the buoy fall into the water; so that a man, falling overboard at night, is directed to the buoy by the blaze on the top of its pole or mast, and the boat sent to rescue him also knows in what direction to pull. The method by which this excellent invention is attached to the ship, and dropped into the water in a single instant, is, perhaps, not the least ingenious part of the contrivance. The buoy is generally fixed afloat-ships, over the stern, where it is held securely in its place by being strung, or threaded, as it were, on two strong perpendicular rods, fixed to the taffarel, and inserted in holes piercing the frame work of the buoy. The apparatus is kept in its place by what is called a slip-stopper, a sort of catch-bolt, or detent, which can be unlocked at pleasure by merely pulling a trigger; upon withdrawing the stopper, the whole machine slips along the rods, and falls at once into the ship's wake. The trigger, which unlocks the slip-stopper, is furnished with a lanyard, passing through a hole in the stern, and having at its inner end, a large knob, marked *Life Buoy*: this alone is used in the day-time. Close at hand is another wooden knob, marked *Lock*, fastened to the end of a line fixed to the trigger of a gun-lock primed with powder, and so arranged that, when the line is pulled, the port-fire is instantly ignited; while, at the same moment, the life-buoy descends, and floats merrily away blazing like a light-house. The gunner, who has charge of the life-buoy lock, sees it freshly and carefully primed every evening at quarters, of which he makes a report to the captain. In the morning, the priming is taken out, and the lock uncocked. During the night, a man is always stationed at this part of the

ship; and every half-hour, when the bell strikes, he calls out "Life-Buoy!" to show that he is awake and at his post, exactly in the same manner as the look-out men abaft, on the beam and forward, call out, "Starboard. quarter!" "Starboard gangway!" "Starboard bow!" and so on completely round the ship, to prove that they are not napping.

Life Preservers.—The human body is a little lighter than an equal bulk of water, so that it naturally floats in this fluid. The mouth, however, in the case of most men lying motionless in the water, would sink below the surface, if the head were not thrown back by a muscular effort. Many persons who fall into still water and are unable to swim, might be saved, if they had any presence of mind sufficient to preserve a proper position. The specific levity of the body, in comparison with water, makes it easy to keep the upper part of it considerably elevated above the surface of the water by attaching to the chest some buoyant substance, even though its bulk be not great; and many contrivances, called life-preservers, have been invented with this view. A great portion of them, however, have been found, in practice, of little or no use. One of the latest is the invention of a Mr. Scheffer, in England. It consists



of a hollow cylinder, formed without a seam, and perfectly air-tight, bent when distended with air and ready for use: or it is what may be termed a cylindrical ring, without a seam, and without a break. Of this ring, the external diameter is generally about 22½ inches, the internal diameter about 12, and the diameter of the cylinder about 5½, the dimensions varying, of course, by being specially adapted to the size of the person by whom it is designed to be employed. It contains a small stop-cock, to which an ivory pipe is fixed. Through this pipe the air is injected by the mouth, and retained by the stop-cock; the adjustment and inflation only occupying the short space of one minute. When unexpanded, it folds up into a very small compass, so as to be conveyed in the pocket; and is also very portable, its weight being but twelve ounces. Another life-preserver, invented by a gentleman of Connecticut, America, does not differ essentially from this, except that it is a straight cylinder. It is made of cloth without a seam, and rendered impervious to water by a preparation of caoutchouc; is about two feet, or two and a half feet long, and eight or ten inches in diameter; is filled like the one first described, and secured to the body by means of straps passing over the shoulders. When empty, it occupies but little room, and may even be worn by a man laboring on the deck of a vessel in danger. He can inflate it in a few moments, when he finds it necessary to trust himself to the waves.

LIBRATION OF THE MOON.

VERY nearly the same face of the moon is always turned towards the earth, it being subject to only a small change within certain limits, the spots near the edge appearing and disappearing by turns; till

called its libration. The moon turns about its axis in the same direction in which it revolves in its orbit. Now, the angular velocity about its axis is uniform, and it turns about its axis in the same time which it makes a complete revolution in its orbit; therefore, the angular motion about the earth were also uniform, the same face of the moon would always be turned towards the earth; for, if the moon had no rotation on her axis, when she is on opposite sides of the earth, she would show different faces; but if, after she has made half a revolution in her orbit, she has also turned half round her axis, then the face, which would otherwise have been shown, will be turned behind, and the same face will appear; and thus, if the moon's angular velocity about her axis were always equal to her angular velocity in her orbit about the earth, the same side of the moon would be always towards the earth; but as the moon's angular velocity about her axis is uniform, and her angular velocity in her orbit is not uniform, these angular velocities cannot continue always equal, and therefore the moon will sometimes show a little more of her eastern parts, and sometimes a little more of her western parts. This is called a libration in longitude. Also the moon's axis is not perpendicular to the plane of her orbit, and, therefore, at opposite points of her orbit, her opposite poles are turned towards the earth; therefore her poles appear and disappear by turns. This is called a libration in latitude. Hence nearly one half of the moon is never visible at the earth, and therefore nearly one half of its inhabitants (if it have any) never see the earth, and nearly the other half never see sight of it. Also, the time of its rotation about its axis being a month, the length of the lunar days and nights will be about a fortnight each. It is a very extraordinary circumstance, that the time of the moon's revolution about her axis should be equal to that in her orbit.

MALLEABILITY OF ALLOYS.

THE malleability and ductility of alloys, are in a great measure referable to the degrees in which the metals of which they are respectively composed, possess these characters. Lead and tin are malleable, flexible, ductile, and inelastic, whilst cold, but when their temperatures much exceed about half way towards their melting heats, they are exceedingly brittle and tender, owing to their reduced cohesion. The alloys of lead and tin partake of the general nature of these two metals; they are flexible when cold, even with certain additions of the brittle metals, antimony and bismuth, or of the fluid metal mercury; but they crumble with a small elevation of temperature, as these alloys melt at a lower degree than either of their components, to which circumstance we are indebted for the tin solders. Zinc, when cast in thin cakes, is somewhat brittle when cold, but its toughness is so far increased when it is raised to about 300° Fab. that its manufacture into sheets by means of rollers is then admissible; it becomes the malleable zinc, and retains the malleable and ductile character, in a moderate degree, even when cold, but in bending rather thick plates it is advisable to warm them to avoid fracture; when again, is remelted, it resumes its original crystalline condition. Zinc and lead will not combine without the assistance of arsenic, unless the lead is in very small quantity; the arsenic makes this and other alloys very brittle, and it is besides dangerous to use. Zinc and tin make, as may be supposed, somewhat

hard and brittle alloys, but none of the zinc alloys, except that with copper to constitute brass, are much used.

Gold, silver, and copper, which are greatly superior in strength to the fusible metals above-named, may be forged either when red-hot or cold, as soon as they have been purified from their earthy matters, and fused into ingots; and the alloys of gold, silver, and copper, are also malleable, either red-hot or cold. Fine, or pure gold and silver, are but little used alone; the alloy is in many cases introduced less with the view of depreciating their value, than of adding to their hardness, tenacity, and ductility; the processes which the most severely test these qualities, namely, drawing the finest wires, and beating gold and silver leaf, are not performed with the pure metals, but gold is alloyed with copper for the red tint, with silver for the green, and with both for intermediate shades. Silver is alloyed with copper only, and when the quantity is small its color suffers but slightly from the addition, although all its working qualities are greatly improved; pure silver being little used.

The alloys of similar metals having been considered it only remains to observe that when dissimilar metals are combined, as those of the two opposite groups; namely, the fusible lead, tin, or zinc, with the less fusible copper, gold, and silver - the malleability of the alloys when cold is less than that of the superior metal; and when heated barely to redness, they fly in pieces under the hammer; and, therefore, brass, gun-metal, &c., when red-hot, must be treated with precaution and tenderness. Muntz's patent metal, which is a species of brass and is rolled red-hot, appears rather a contradiction to this; but in all probability this alloy, like the ingots of cast-steel, requires at first very nice attention to the force applied. It will be also remembered the action of rollers is more regular than that of the hammer; and soon gives rise to the fibrous character, which so far as it exists in metals, is the very element of strength when it is uniformly distributed throughout their substance.

NEW CEMENTS.

BY COLONEL MACERONI.

I HAVE for many years past been induced to experiment on the best mode of making cement to join wood, glass, china, &c. Amongst other things I had to glue the parts of my artificial shafts for my apparatus for flying in the air by purely mechanical means, in which I so far succeeded as to form shafts 24 feet long, and weighing only 3 lbs. that would support my weight suspended from the middle.

I also endeavoured to form a cement much stronger than glue, and indissoluble in water, for joining parts of fishing rods, &c. of which I have made for my own use, far superior to those of the trade. White of egg and oyster-shell lime make a very good cement; but the best was a basis of shellac. This I united with another substance; and that you may judge of its adhesive power I will mention a fact.

In 1833 I purchased a huge globular bottle, called a tarboise, for the purpose of forming it into a vase, in which to keep gold and silver fish. To suit it for this purpose, it was necessary to cut off the neck, so as to form an aperture of at least six inches diameter. This I accomplished in the well-known way of winding round it several turns of string soaked in spirits of turpentine, then setting the string on fire, and throwing on it a bucket of

cold water when the flame is about to expire. The separation instantly takes place cleanly where the string was burning. But in this case I used too much turpentine, some drops ran down the sides and caused several vertical cracks. To remedy this error, I wound round the upper edge of the glass globe a long piece of silk ribband, steeped in the compound shellac cement I above allude to. The vase remained exposed to the weather and rain, during two months, in my garden, but I observed that the ribband firmly adhered. I took it into my head to try its state upon the glass. Upon tearing off a part that touched the glass, numerous scales of glass were brought away, and adhered to it like scales upon a fish!

I then placed a joint of a fishing-rod joined with this cement in a water-butt. After a week's immersion the cement was as firm as ever, without any binding over the joined part, or any varnish.

So much for marine cement—except that I must say, that shellac will not do alone. Its tenacity is wonderful in a straight pull, but it is somewhat too brittle. I have opened many a well-corked bottle of wine with a stick of sealing-wax, but the pull be not quite vertical, the connexion breaks.

It is well known that Indian rubber, when once dissolved, merely by heat, will never again solidify, but remain a clammy tar-like substance, without any power of adhesion. I endeavoured to combine caoutchouc with shellac, but did not succeed to my wish, probably from lack of manipulative skill and other means. But the composition which I have above alluded to, which pulls scales off a glass bottle, and is unaffected by the rain for many weeks, will do for all the purposes that I can think of.

For the amusement of chemical readers I will mention that I have made an artificial caoutchouc, which in appearance and elastic feel cannot be distinguished from the real, but is not quite insoluble in water. It is thus: dissolve an equal weight of glue and treacle over a mild fire, in an iron vessel; then add the like weight of linseed oil. This mixture will soon amalgamate, and the product will be such, in appearance and elasticity, as to make any one swear that it is caoutchouc.

COQUILLA AND COROSOS NUTS.

COQUILLA nuts are produced in the Brazil by *Attalea funifera*, according to Martius, or the *Cocos lapidea* of Gartner; the latter title is highly descriptive. The shell is nearly solid, with the exception of two separate cavities each containing a hard, flattened, greasy kernel, generally of a disagreeable flavor: the cells occasionally inclose a grub or chrysalis which consumes the fruit. The passages leading into the chambers are lined with filaments or bristles, and this end of the shell terminates exteriorly in a covering of these bristles, which conceal the passages; this end is consequently almost useless, but the opposite is entirely solid, and terminates in the pointed attachment for the stalk. Sometimes the shell contains three kernels, less frequently but one only.

The substance of the shell is brittle, hard, close, and of a hazel brown, sometimes marked and dotted but generally uniform. Under the action of sharp tools it is very agreeable, more so than the cocoa-nut shell; it may be eccentric turned, cut into excellent screws, and admits of an admirable polish and of being lackered. On the whole it is a very useful material; it is suitable for a great variety of small

ornamental works both turned and filed, and is extensively manufactured into knobs of umbrellas and parasols, small toys, &c.

Corosos, or Ivory-nuts, are produced by *Phyle-lephas macrocarpa*, growing in Central America and Columbia, (Humboldt.) They are described as seeds with *osseus albumen*: the tree is a genus allied to the *Pandaneæ*, or Screw Pines, and also to the Palms. The nuts are of irregular shapes, from one to two inches diameter, and when inclosed in their thin husks, they resemble small potatoes covered with light brown earth: the coat of the nut itself is of a darker brown, with a few loose filaments folded upon it. The internal substance of the ivory-nut resembles white wax rather than ivory; it has when dried, a faint and somewhat transparent tint, between yellow and blue, but when opened it is often almost grey from the quantity of moisture, in losing which it contracts considerably. Each nut has a hole, which leads into a small, central, angular cavity; this, joined to the irregularity of the external form, limits the purposes to which they are applied—principally the knobs of walking-sticks, and a few other small works.

MEMORANDA.

An extraordinary Bar of Iron.—The largest bar of iron ever made was rolled at the Cyfartha iron-works, near Merthyr Tydvil, last week. It is a cable-bolt, 25 feet in length and 6 inches in diameter, weighing about 2,400 lbs. The pile from which it was rolled was about 7 feet long, by 12 inches square, and weighed upwards of 2,600 lbs. The pile was taken from the heating-furnace and put at once into the rolls, just in the same manner as they roll bars of an ordinary size. It was rolled under the superintendence of Mr. Robert Crawshaw.

Another Steam Leviathan.—We learn from the New York papers, that the largest steam-boat in the world was expected to be shortly launched from the ship-yard of Wm. H. Brown. She is built for the Troy Company, and will run on the Hudson River between Troy and New York. She is 333 feet in length, and her breadth of beam, exclusive of guards, is 30 feet 6 inches. Her burden will be about 1000 tons, and it is supposed she will prove the fastest boat ever built.—*Montreal Herald.*

Writing Ink.—The late Dr. Wollaston recommended the following mode of making ink. Eight ounces of Aleppo galls, coarsely powdered; four ounces of gum-arabic; four ounces of green vitriol; a quarter of an ounce of cloves, also coarsely powdered. Pour two quarts of boiling water on the galls, and stir frequently till cold: the next day pour off three pints of the infusion. Dissolve the gum-arabic in hot water, to make half a pint of mucilage, and mix this thoroughly with the infusion. To this mixture then add the vitriol (previously dissolved in hot water), and the cloves. When poured off for use, care should be taken not to disturb the sediment.

Ivy.—In rooms, ivy planted in boxes and properly trained may be made to form a rustic screen, either to soften the light or exclude a disagreeable view; and in large drawing-rooms, trained on frame-work, may form rustic canopies, similar to orange-tree shades used in Berlin, &c.—*London.*

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END OF THE FOURTH VOLUME.

ERRATA.—Expunge answer to the first query on page 264, and take as an answer to it the paper on "Galvanic Depositions" on page 357.

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3. Ambergria, Artificial—Ambergria, Essence of—Ambergria Hair Powder—Ambergria Perfume—Ambergria Soap—Ambergria, Spirit of—Ambergria Wash Balls—Amboyne Wood, to Imitate by Painting—Ambrette Perfume—Ambrette, Spirit of—American Biscuits—American Blight, Cure for—American Mead—Amethyst Paste—Ammoniacal Preparations, Acetate of, Embrocation, Liniment, Plaster, Spirit of, Aromatic Spirit of, Compound Spirit of, Fœtid Spirit of, Succinated Spirit of, Lavender Water—Ammoniacum, Essence of—Ammoniacum, Fomentation of—Ammoniacum, Mixture of—Anatomical Preparations—Anatomical Injections—Anchovies British—Anchovy, Essence of—Anchovies, Transparent Essence of—Anchovy Powder—Anderson's Scotch Pills—Angelica Green, to Candy—Angelica, Spirit of—Angelica Cream—Angel Water—Animal Charcoal—Anise—Anise Creme—Anise Powder—Aniseed, Balsam of—Aniseed Cordial—Anisette de Cordoux—Annatto, English—Annatto Purified—Annatto to Dye Wool with—Annatto to Dye Silk—Annatto to Dye Cotton—Annatto to Color Cheese—Anodyne Medicines, Bolus, Drops, Enema, Essence, Fomentation, Julep, Mixture, Liniment, Poultice, Necklaces—Anodyne Ball for Horses—Anodyne Drench for Horses—Antacid Medicines, Draughts, Mixture, Powder—Anti-Asthmatic Powder—Anti-Attrition Paste—Anti-Bilious Medicines—Anti-Emetic Medicines—Anticardium—Antimonial Powder—Antimony, Regulus of—Antimonial Wine—Anti-Scorbutic Medicines, Infusion, Mixture, Juices, Wine—Anti-Septic Medicines, Draught, Fomentation, Gargle, Mixture—Anti-Spasmotic Medicines, Draught, Enema, Mixtures, Pills—Ants, to Destroy—Aperient Medicines, Draught, Powder, Pills, &c.—Apiary, to Establish—Apoplectic Balsam—Apoplexy.

4. Apples, to Preserve—Apples, to Dry—Apple Biscuits—Apple Bread—Apple Cheese—Apple Jelly—Apple Marmalade—Apple Paste—Apple Sugar—Apple-tree Canker, to Cure—Apple-water Ice, Apple Ice Cream—Apple Wine, White, Red—Apricots, Green, to Preserve—Apricots, Ripe, to Preserve—Apricot Biscuit—Apricot Ice—Apricot Paste—Apricot Wine—Aquafortis, Single, Double, Strong, Spirit of Nitre, Dilute, Proof, Compound—Aqua Potens—Aqua Regia—Arabic Gum, to Choose and Test—Archil or Orchil—Archil, to Dye Wool—Archil, to Dye Silk—Argentum Vivum—Armenian Cement, or Turkish Glue—Aromatic Medicines, Confection, Draught, Electuary, Fomentation, Mixture, Plaster, Pills, Powder, Tincture—Aromatic Spirit of Ether—Aromatic Vinegar—Arquebuse Water—Arrack, Mock, or Vauxhall Nectar—Arrow Root, to Test—Arrow Root, British—Arsenical Paste—Arsenical Soap—Asarabacca Snuff—Asiatic Dentifrice—Asphaltic Mastic—Assafœtida, Emulsion of—Assafœtida Mixture—Assafœtida Pills—Assafœtida Plaster—Assafœtida, Tincture of—Assayer's Acid—Assayer's Muriac Acid—Assayer's Fluxes, Crude or White Flux, Black Flux, Cornish Reducing Flux, Cornish Refining Flux—Asses' Milk, Artificial—Asthma—Asthmatic Elixir—Astringent Medicines, Draught, Enema, Fomentation, Gargle, Infusion, Lotion, Mixture, Ointment, Pills—Astringent Cattle Medicine, Balls for Horses, Drench for Horses, Enema or Clyster for Horses, Ointment for Horses, Powder for Horses—Ausburch Beer—Auld Man's Milk—Aurum Musivum—Aurum Sulphuratum—Austrian Wine—Azure Blue.

5. Bacon, to Cure—Badigeon, to Make—Badolier's Vinegar—Bailey's Itch Ointment—Baldness, to Cure, Oil for, Pomatum for, Wash for—Baldwin's Phosphorus—Balloons from Turkey's Crops—Balloons, Varnishes for—Bailey's Digestive Draught—Balsamic Vinegar—Balm Water—Balm Wine—Balsamic Injection—Balsamic Powder—Banbury Cakes—Bandoline for the Hair—Barbadoes Cream—Barbadoes Water—Barberry Cream—Barberries, to Preserve—Barberry Drops—Jelly—Barclay's Antibilious Pills—Barege Water—Bark Peruvian, Tincture of, Compound, Simple, Concentrated—Barker's Tooth Tincture—Barley Banquets—Barley Sugar—Barley Sugar Drops, or Kisses—Barley Water—Burnstable Ale, to Brew—Basil Wine and Vinegar—Basilicon Ointment—Basilicon Powder—Bass's Pale Ale; India Ale, &c.—Bates's Anodyne Balsam—Bates's Pectoral Drops—Bates's Stiptic Wash—Bath Bricks—Bath Buns—Bath Cakes—Bath or Liquorice Pipes—Batteries, Solutions for, Daniell's Battery, Grove's Battery, Leeson's Battery, Smee's Battery, Sturgeon's Battery, Wheatstone's Battery—Battley's Green Senna Powder—Battley's Liquor Opi Sedativus—Bavarian Ale—Baume's Spirit of Wine—Bays, Oil of—Bear's Grease—Beauty Water—Bedford Biscuits—Bee, Sting of, to Cure—Beech Black—Beer—Beer for the Table—Beer from Sugar or Treacle—Beer from Pea Shells—Beer, to Improve—Beer, to Prevent Acidity in—Beer, to render Intoxicating—Beer, when Foxed, to Restore—Beer, when Frosted, to Restore—Beer to Restore when Sour, Flat, &c.—Beer Bottled to Ripen.

6. Beet Poultice—Beet Root Sugar—Belladonna, Tincture of—Bell Metal—Belloste's Pills—Bell's Bougea—Bending Glass Tubes—Benjamin, Flowers of—Benzoin, Tincture of—Bergamot, Oil of—Bergamot Perfume—Bergamot Water—Berlin Green—Berlin Vinegar—Berries, Wine from—Bestucheff's Nervous Tincture—Bice, Biddery Ware—Bilberry Wine—Birch Oil—Birch Tree Sugar—Birch Wine—Bird Lime—Birds in Gardens, &c.—Blacottes de Bruxelles—Blacuits, to make—Blacuit Drops—Blacuits of Fruit—Blacuits, Purgative—Bishop, Blaire Bitters, Medicinal—Bitters for Liqueurs, &c.—Black-ash—Black Chalk—Black Composition—Black Drop—Black Eyes—Black Draught—Black Enamel—Black Flux—Blacking for Shoes, &c.—Blacking Cakes—Blacking Balls—Blacking the Edges of Books and Paper—Black Japan—Black Lozenges—Black Reviver—Black Varnish for Metal—Blackberry Wine—Black Lead Pencils, artificial—Black Lead Drawings, to Fix—Bladders, &c. to Prepare—Blaine's Powder—Blanched Copper—Blanchange—Bleaching Liquid—bleaching Liquid Extemporaneous—Bleeding at the Nose—Blight on Rose Trees, to Destroy—Blistered Feet, Cure for—Blister Liquid—Blister Plaster—Blisters for Horses.

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Contents of No. 7. Blond Lace, to Blanch—Blood, Powdered—Blood Cement—Blood, Spitting of—Blun Ashes—Blue Black—Blue Dyes, for Cotton, Silk, & Wood; Bone, Ivory and Feathers—Blue Enamel—Blue Eye Water—Blue Fire—Blue Mottled Wash Balls—Blue Ointment—Blue Paints, for House Painting, Artists, Water Colors, Distemper—Blue, or Mercurial Pill—Blue Signal Lights, Bengal Lights—Blue Stone or Blue Vitriol—Pale Colored—Blue Verditer—Blue Writing Ink—Boerhaave's Astringent Powder—Boerhaave's Red Pill—Bohemian Glass, Crown, Flint, Plate—Boiled and Baked Oil—Boils—Bologna 1st Phosphorus—Bologna Sausages—Bologna Wash Balls—Bon Bons—Bone Black, Dyes for Red, Scarlet, Black, Purple, Yellow, Brown, Blue, Green—Bone Glue—Bone Grease—Books, Gilding the Edges—Books, Lettering the Backs—Books, to remove Stains from—Boot Powder—Boot Varnish—Boots, Waterproofing—Boot Tops, to Clean—Borax, Gargle—Borax, Glass of—Bordeaux, or Parisian Cakes—Bordeaux, Imitative—Boss's Hard Varnish—Botany-bay Cement—Bottle Glass—Bottling of Malt Liquors—Botts in Horses—Bougie—Bougavil, White—Bouquet de la Reine—Bouquet Water—Box-Wood for Engraving, to Choose, to Prepare, to Draw upon—Boyle's Depilatory—Boyle's Fuming Liquor—Bramble Biscuits—Bran Bread, to make—Brandy, British—Brandy from Beet Root, to make—Brandy from Potatoes, to make—Brandy, to give Apparent Age to—Brandy, to give a Head to—Brandy Balls—Brandy Bitters—Brandy Flavor—Brandy Shrub.

No. 8. Brass—Brass Ornaments to Preserve—Brass Work, Bronzing—Brass, Pastes for Cleaning—Brazil Snuff—Brazil Wood Lakes—Brazil Wood, Tincture of—Bread, to make, on Cobbett's Plan—Bread, to Prepare in the Method of the London Bakers—Bread Excellent, to make—Bread from American Flour—Bread, to Detect Adulteration in—Bread without Yeast—Bread Seals—Breakfast Powder—Bread, to Sweeten—Bree's Anti-Asthmatic Plaster—Breeches Ball—Bremen Green—Brewing—Brewing Utensils, to Preserve—Brick, Oil of—Brick, Oil of, Fictitious—Brilliant Composition for Fire-Works—Britannia Metal, or Tutania—British Gum—British Oil—British Tooth Powder—Brodum's Nervous Cordial—Broken Knees of Horses—Bronze, for Statuary, for Medals, for Cutting Instruments, for Mortars, for Ornaments—Bronze of the Ancients—Bronze Liquids—Bronze, to Darken—Bronze Powders—Bronze to, with Oil Color—Bronze, Printing in—Bronzing, Cleaning for—Brown Dyes, for Cotton, for Silk, for Wool, for Wood—Brown Enamel—Brown Paints, for House Painting, Artists' Colors, Water Colors—Brown of Prussian Blue—Brown Pink—Brown Ointment—Browning for Cookery—Browning of Gun Barrels—Bruceine Pills—Bruises—Bruises of Horses—Brunswick Black Cheap—Brunswick Green—Buccaned Meat—Buckthorn, Syrup of—Bug Poison—Bull's Eyes—Bunions.

No. 9. Buns—Burgundy Pitch Plaster—Burns and Scalds—Burnt Sugar, Solution of—Barton Ale, to make a Hogshead of—Butter, to Clarify—Butter, to Improve—Butter, to Preserve—Butter preserved with Honey—Butter, to Pack—Butter Biscuits—Butterflies, to Take Impressions of—Buxton Water—Butter of Antimony—Cacao—Cajeput, Liniment of—Cajeput, Oil of—Cajeput, Opodeldoc—Cake—Calamine, Prepared—Calamine Cerate or Ointment, Simple, Compound—Cajot's Soft Engraver's Varnish—Calomel, to Test if Pure—Calomel Pills—Calomel, Flowers of—Calomel Ointment—Calotype Paper—Calumbo Bitters—Calves to Rear, without the Cow—Camomile Drops—Camomile, Essence of—Campbell's Green Lament—Caneos, &c. to Carve—Canniborated Chalk, Varnishes, Copal, Sandarac, Spirit, Vinegar, Wine—Camphor Balls, Balls in Farriery, Cakes, Liniments, Simple, Compound, Draught, Drink for Horses, Emulsion Ointment, Mixture—Camp Vinegar—Canals, Cement for—Candied Sugar—Candles, to Make—Cantharides, Oil of, Tincture of—Canton's Phosphorus—Canker in Apple Trees, to Cure—Canvas Prepared for Paintings—Caoutchouc, how Prepared—Caoutchoucine, to Deprive of Odour—Caoutchouc, Liquid—Caoutchouc, solvents for—Caoutchouc, Varnish—Caoutchouc Balloons—Capers, French, English—Capillaire—Capsicum Spirits of—Capsules for Medicine—Captain's Biscuits—Caramel Sugar—Caratch Sauce—Carbonated Lime Water—Cardamon, Tincture of, Simple and Compound—Cardamon Water—Carmine, to Prepare, Adulteration in, Liquid, Blue, Purified, Lake from Madder.

No. 10. Carminated Lake for Crayons—Carminative Medicines—Drinks for Cattle—Carraway Brandy, Cordial, Water, Comfits—Cascarilla, Tincture of, Water—Casks, Seasoning of when New, to Sweeten when Musty, Misch for Sweetening—Cassel and Cologne Earths—Cassia, Electuary of, Conserve of—Cassis, Ratifia de—Cassius, Purple Precipitate of—Castle Soap, English Imitation of—Castor, Tinctures of, Oil Clyster, Oil Draught—Case Hardening—Catchup, Mushroom, for Sea Store—Caterpillars, to Prevent their Ravages—Catapu Ointment, Tincture of, Confection of, Lozenges, to Make—Cathartics, Pills—Catheter—Catherine Wheels—Catholicon Duplicatum Rheo. P.—Cauliflowers, to Pickle—Caustic Medicines, Common, Mild, Lunar, Liquid, Opium; for Canker in Horses—Cayenne Pepper, Reduced, Prepared, Essence of, Brandy, Wine, and Vinegar—Cedrat Cordial, Essence of—Celery, Essence of—Cement—Cephaleic Snuff, Plaster—Cerule, Simple—Cerule Ointment—Chalk, Compound Powder of, Precipitated, Prepared—Chalybeate Pills, Iron Powder, Water Artificial, Wine—Chamberlain's Restorative Pills—Champagne, Imitation of—Charcoal, to Make, Crayons for Drawing, Poulitice—Cheese Cakes, Cement—Chelsea Pensioner, Buns—Cheltenham Salts, Water, Imitative—Chemical Wash Balls—Chemists' Bottles, Colors for.

No. 11. Cherry Bounce or Brandy, English, Imitative, American, French, Water, Wine—Cheshire Cheese, to make; Salt, Basket, Common, Hay, Fishery—Chevalier's Alcohol—Chevenix's Antimonial Powder—Chian Turpentine, Fictitious—Chicken Pox—Chilblains, Lotions for, Onaments for—Chille Vinegar—China or Glass, Cement for—China Ink, Locksby—Chinese Composition for Japan Work, Fires for Fireworks, Flyers, Paste, Propagation of Fruit Trees, Sheet Lead, Yellow, to make—Chung's Worm Lozenges—Chintz, to Wash—Chlorinated Soda—Chlorine Gas or Liquid—Chocolate—Chocolat a la Vanille—Chocolate Stomachic, Brandy, Drops, Cream, Ice—Chrome Red, Yellow—Cider, to make, from Ruins, to Improve, Champagne, Wine—Cinnamon Cakes, Comfits, Cordial, Lozenges, Soap, Syrup of, Water and Spirit—Circassian Cream, Citric Acid—Citron Cordial, Oil of, Peel, Candied—Citronella—Citret, Rosin de six Grains—Clarence Biscuits—Claret Rags, Imitative, to Darken, to Fino, to Manage, when Foul to Restore—Clarifying Powder.

No. 12. Clary Wine—Clater's Drink for Sheep—Cleansing Poulitice for Cattle—Cloth Clothes, to Scour—Clothes, to Perfume, to Preserve, Ball, Powder—Clotted Cream—Clove Cordial, Pink, Extract and Syrup of, Lozenges—Clover Seed, to Detect Doctored—Clotton's Febrifuge Spirit—Cluzell's Kermes—Coal Balls—Cobalt Blue—Cochineal, Syrup of, Wash Balls—Cochrane's Cough Medicine—Cockroaches, to Destroy—Coffee Biscuits, Milk, Ice, Ratifia, Substitutes for, Corsica, Currant, Egyptian, American, Holly, Broom, Rice, German, French, Rosetta, Rye, Iris, Sassafras—Comdet's Pills—Coins of Sulphur, Moulds for—to Make—Colchicum, Powder of, Tincture of, Vinegar—Cold or Catarrh—Cold Cement, Cream—Colepresse's Cider—Colic Ball for Horses—Collett's Tooth Ache Drops—Colloy's Depilatory—Colocyath Clyster—Coloring for Liquors—Composition Ornaments—Comfits—Concrete—Confectionary—Congreve Lucifers—Constant White—Contrayerva Pills, Powder—Copalba Balsam, Mixture of, Salts of—Copal, Solvents for, Varnishes—Copper for Engraving, to Gild, to Tin, Medallions, Plates, Copper Plate Printing Inks—Copperas, Green, Green Vitriol Calcined, Water.

No. 13. Copying Machine—Corn for Grottos, Powder, Syrup, Tooth Powder—Cordial Mass—Coriander Cordial—Cornuchin Pills—Corn to Preserve—Cornelian—Cornish Fluxes, &c.—Corns—Corrosive Sublimates—Cosmetic—Cotophan Cream—Cotton Goods, Bleaching of—Cough, Medicine for, Lozenges, Court Plaster—Cowslip Mead, Wine—Coventry Cakes—Crackers—Cracknels—Cramp in Bathing, in the Leg, in the Stomach—Cranberry Jelly—Crayons for Drawing, Colors for, White, Carmine and Lake, Vermillion, Yellows, Blue, Browns, Greens, Black, Paste for, Method of making, Marks, to Erase, Drawings, to Fix, for Drawing on Glass—Cream, Iced, of Tartar, Balls, of Rose, Substitute for—Crespigny's Pills—Crickets, to Poison—Crimson, to Dye Silk—Crocus, of Gold, of Iron of Antimony—Cross Buns—Croton, Tincture of—Crows from a Field, to Banish—Crucibles, Composition of—Crumpets—Crystal Glass, Powder, of Tartar—Crystallized Microscopic Objects.

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Contents of No. 14. Crystallized Windows—Crystals of Salts, Varnish—Cubeba, Tincture of—Cucumbers, to Pickle, Vinegar—Culley's Salve for Rot in Sheep—Cumin Plaster, Water—Cup Cakes—Curd for Cheese—Cheese Cakes, Soap—Curling Fluid—Curaçon—Currant Clear Cakes, Jam, Jelly, Shrub, Wine—Curry Powder, Imitative, Wine, Lord Clive's Powder—Cutler's Cement—Custards—Cuts—Cypress Powder, Gross—Cyprus Wine, to Imitate—Cyrillo Pomatum—Daffy's Elixir—Daguerre's Photogenic Paper—Damask Powders—Dampness in Beds, to Detect—Damp Walls—Damon's to Bottle, Cheese, Wine—D'Arcey's Digestive Lozenges—Dead Fire for Fireworks—Deafness—De Brun's Eye-Water—Decanters, to Clean—De la Motte's Golden Drops—Delcroix's Powder Subtile—Delescott's Myrtle Opiate—Demulcent Electuary—Dentifrice Electuary—Depilatories—Derbyshire Spar, Cement for—Detergent Medicines—Devil's Elixir—Devonshire Cider—Dextrine—Diachylon Plaster—Diagrydium—Diamonds, Paste for—Diaphanix Electuary—Diaphoretic Apitumey—Diarrhea, to Check.

No. 15. Diet Drinks—Digestive Lozenges, Medicines—Dinner Pills—Dippel's Oil of Hartshorn, Acid Elixir—Discharge, Colors to—Distemper in Dogs, among Cattle—Distillation of Simple Waters, to Preserve Flowers, for—Diuretic Medicines, Balls for Horses, Sift—Dixon's Antibilious Pills—Doluss' Acetous Acid—Dolichos, Electuary of—Donovan's Mercurial Ointment—Dorchester Ale—Doses, to Regulate—Dover's Powder—Dragon's Blood, Fictitious—Drowning Recovery from, Stripping, Removal of the Body, Warmth, Fresh Air, Inflation, Fomentations, Cordials, Bleeding—Drunkennes, Recovery from—Drying Oils for the Palsters—Dupuytren's Eye Salve—Duriets' Anti-Hysterie Elixir—Dutch, Cinnamon, Drops, Pinka, Terras—Dyer's Aqua fortis, Spirit—Dysentery—Ear-Ache—Earthenware, Enamel for—Ear-Wigs, Traps for—East India Pills, Tanjore Pills—East India Pomatum—Eaton's Styptic Wash—Eau D'Arguebuse, de Bouquet, de Cologne, de Luce, de Marchule, de Melisse des Carmes, de Mille-Flours, Divine, Sauspareil—Eccles Cakes—Edinburgh Ale—Ech Ointment—Effervescing Emulsion, Poultice—Eggs, Pickled, to Preserve, Flip—Egyptian Azure—Elder Brandy, Flower Wine, Ointment, Wine—Ellecampagne, or Candy Cake.

No. 16. Electrical Cement, Varnish—Elephant's Milk—Elixir of Vitriol—Embrocation, Common—Emeralds, Imitative—Emetics—Emollient Enema, Poultice—Enamel for Saucapans, &c.—Encaustic Painting, Medium for—Enema, Common—Engineer's Cement—English Verdigris—Engravings, Cleaning of—Engravings, to Transfer to Plaster—Epilepsy, Electuary for—Ergot, Essential Solution of—Escharotics—Essentia Bina—Essex Ale to Brew—Etching Acids, for Biting in, for Copper, for Glass, for Marble and Stone—Etching Ground—Etching Ground, to Lay—Etching on Glass, a Varnish for Covering preparatory to—Exchequer Ink—Exeter Oil—Extempore Smelling Salts—Eye Salve—Eye Snuff—Eye Waters—Face, to Take a Cast from—Fainting Fits, to Recover from—Fancy Biscuits, to make—Farcy Balls for Horses—Feathers for Bedding, to Cleanse—Feathers for Ornaments, to Prepare—Fenouillet—Fetid Pills for Hysterics—Fever Ball for Horses, Fever Powder for Horses—Fermentation, to Manage—Fermentation, Accelerators of—Fermentation, to Check or Stop—Fever—Field's Extract of Vermilion—Figures, of Varnishing—Filberts, to Preserve—Filters, to make.

No. 17. Filtering Bag—Filtering Machine—Fincham's Purifying and Disinfecting Liquid—Finings, for Beer or Ale—Fire, to Escape from—Fire and Water-Proof Cement—Fire-Proof Paints—Fire Proof Stucco—Fish, to Preserve with Oil, Acid, Creosote, Sugar—Fish, to Preserve Alive—Fish Oil Paints—Fit Drops—Fixature for the Hair—Flake White—Flash—Stalulence, Remedy for—Flemish Glass—Flexible Pain—Flint Glass, Composition of—Florentine Lake, to Prepare—Floors, Cement for—Florey Black—Flour, to Detect Adulterations in—Flour Paste, to make—Flower of Antimony—Flowers, to Restore—Flowers, to Extract the Perfume of—Fluid Magnesia—Flute Key Valves—Fluxes—Flux, Remedy for—Fluxes for Enamels—Fly in Sheep—Fly on Turnips, to Destroy—Fly Water—Fools, to Make—Fools, to Silver—Fools to Color—Foliage, Plaster Casts of—Fomentations—Ford's Laudanum—Foreign Wine—Fossil Woods for the Microscope—Fothergill's Pills—Fox's Cream for the Hair—Fractured Limbs.

No. 18. Frankfort Black—Freckles and Sunburns—Frenian's Bathing Spirits—Freezing Mixtures for making Ice Artificially—French Cement—French Glue—French Oil for Furniture—French Polishing, &c.—French Pomane—French Red, French Sealing Wax—Fresco, Colors for—Friar's Balsam, &c.—Frit—Frontinac, Imitative—Fruit Biscuits—Fruits, to Bottle—Fuel, Manufactured—Fulgokali—Fulminating Powder, to make—Fulton's Decorated Pepper—Fumigating Pastilles—Foul Rooms to Fumigate—Furniture Polishers—Furs, to Preserve—Fuso for Military Shells—Fusses, to make—Fusible Alloys—Fusible Metal, Casts from—Galbanum, Plaster of, &c.—Gall, to Purify for the Artist—Gall Drops—Gall Opodeldoc—Gall Stone, an Artist's Color—Gall, Syrup of—Gallipot Varnish—Galls Ointment, &c.—Galvanized Iron—Gamboge Pills—Gargle, Common—Garlic Balls for Horses—Garlic, Syrup of—Garlic Vinegar—Garnets, Artificial—Gascolgne's Powder—Gelatine—Gelatine from Bones—Gem Cutter's Plate—Gems, Red Sulphur—Gentian, Infusion of, &c.—German Blacking—German Paste—Gilder's Varnish—Gilding.

No. 19. Gilding Liquid or Pickle—Gilding Metal or Alloy—Gilding Wax—Gilead, Balm of, Fictitious—Gin—Gin, Finings for—Ginger Beer in Bottles—Gingerbread—Ginger Cakes—Ginger, Essence or Tincture of—Ginger, to Candy—Ginger Candy—Ginger Lozenges—Ginger Candy and Drops—Ginger to Preserve—Ginger Powders—Ginger, Mock Preserved—Ginger Brandy or Cordial—Ginger, Syrup of—Ginger Wine—Gins—Glass, Cutting and Breaking of—Glass, to Drill, for Thermometers—Glass and Porcelain, to Gild—Glass, to Powder—Glass, to render opaque—Glass Bottles to Clean—Glass, Staining of—Glass, Staining, Colors for, Flesh, Black, Brown, Red, Rose Color, Bistre and Brown Red, Green, Yellow, Orange, Purple, Blue—Glass Cloth and Paper—Glass Grinder's Cement.

No. 20. Glass Seals—Glauber's Tincture of Iron—Glaze for Pottery Ware; for Porcelain, White Ware, Printed Ware, Painted Ware, Raw Glazes, Ironstone Ware, Green Ware, Red Pottery Ware—Glaze for Cooking—Glazed Boards, to Clean—Glazier's Putty—Gloves, to Clean; Kid Gloves, Dow or Buckskin Gloves—Gloves to Dye—Gloves, Perfumes for—Glues—Glue Cement—Glue Varnish—Godhold's Vegetable Balsam—Godfrey's Cordial—Godfrey's Smelling Salts—Gold Alloys—Gold Articles, to Cleanse—Gold, to Color, Green, Red—Gold Cordial—Gold Beater's Skin—Gold Ink—Gold-colored Lacker—Gold Lace and Embroidery, to Clean—Gold, Liquid or Potable—Gold Powder—Gold Rain—Gold Sealing Wax—Gold Shells—Gold Size—Gold, Solder for—Gold Varnish for Leather—Gooseberries, to Keep—Gooseberry Champagne—Gooseberry Cheese—Gooseberry Ice—Gooseberry Jam—Gooseberry Jelly—Gooseberry Marasquin—Gooseberry Vinegar—Gooseberry Wine—Goulard's Extract of Lead—Goulard's Eye Water—Goulard's Linctament—Goulard's Ointment—Goulard Poultice—Goutlema Acres—Gout, Cordial, Linctus, Linctament—Grapes, to Preserve—Grape Wine—Gravel—Grease from Cloth, to Remove—Grease from Paper, to Remove.

No. 21. Grease from Silks, to Extract—Grease of Horses Hoofs—Grecian Water—Green Balsam—Green Bile—Green Dyes—Green Dye for Black Cloth—Green Fly, to Destroy—Green Ink—Green Oil—Green Ointment—Green Precipitate—Green Sealing Wax—Green Tooth Powder—Green Liniment—Greenough's Tincture for the Teeth—Green Paints—Gregory's Powder—Green's Benzoic Acid—Grenoble Bataffe—Grey Lotion—Grey Dyes—Grey Colored Fire—Griffin's Tincture—Grindstones, Artificial—Grindle's Cough Drops—Gripes in Horses, Remedies for—Grosvenor's Tooth Powder—Guaiacum, Infusion of—Guaiacum Mixture—Guaiacum Tincture of—Guastonian Embrocation—Guido's Balsam—Gum Anglicum—Gum Arabic, Mucilage of, Emulsion—Gum Julep, Lozenges and Pastilles, Paste for, Comfits, Plaster, Seals—Gumption for Artists—Gun Powder, to make, Barrels, Browning of, Cotton, Metal—Gut, for Anglers—Guthrie's Black Ointment—Guthrie's Eye Ointment—Guy's Powder of Ethiopia—Guyot's Spirit—Habnemann's Wine Test—Hulford's Sir H. Nervous Tincture—Hair for Wigs, to Prepare—Hair, Superfluous, to Remove—Hair, to Sort and Cleanse—Hair to Bleach—Hair to Dye—Hair Powder, for Lame, Rico, Flour, &c.—Hair Powder Perfume—Hamburg Pickle—Hams, to Cure—Hamel's Cement, to Make—Hard Grenado—Hannan's Hair Dye—Hard Glass for Artificial Gems—Hard Varnishes.

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No. 23. Hot Cement—House Painting, Colors for—Hawes Antiques, L'Orange, L'Rose, La Tuberoze, De Venus, and Liqueureuses—Hungarian Liniment—Hungary Water—Huxham's Bark Tincture—Hyposulphite of Soda—Hysterics—Ices, Ice Cream, and Icing for Cakes—Iceland Moss Jelly—Illumination Fire—Impenetrable Mortar—Imperial Drinks and Liquids for the Hair—Incantations, Theatrical—Indestructible Ink—Indian Cement and Corn Foods—Indian Hemp, Tincture and Extract of, and Lozenges—Indian Ink, to Choose and Imitate—Indian-rubber Blacking Tubes, Oil, &c.—Indigestion—Indigo, to Prepare and Obtain, Blue and Sulphate of—Infant's Preservative—Inflammation.

No. 24. Influenza—Infusions—Injections, Metallic—Ink, Black—Intoxication, Insensibility and Apparent Death from—Insects, Bites and Stings of—Iodine, Solution of—Iodine and Ioduretted Medicines—Iperacuanha Linctus, Lozenges, Pills, Powder, Tincture, and Extract of—Irian Moss Jelly—Iron Cement, Gilding, Liquor, and Sand—Iron, Medicines of—Iron to Tin, and preserve from Rust—Iron-Work Black—Iron Plates, Tinning of—Iringlass Cement, &c. &c.

No. 25. Iringlass Glue, Jelly, and Mucilage—Issue Pens and Plasters—Italian Bread, Cream, and Varnish—Itch—Ivory Black, to make—Ivory, to Bleach, Dye, Rich, Smooth, &c.—Ivory Jelly—Jackson's Itch Ointment—Jalap, Draught, Elixir, and Powder of—Jamaica Pepper Water—James's Analeptic Pills and Powder—Jams of Fruit, to keep from Mould—Janin's Eye Ointment—Japan for Leather and Tin-ware—Japan Gold Size and Ink—Japanese Cement—Japaner's Copal Varnish—Jasmino, Essence and Oil of, Hair Powder, Pomatum, and Water—Jaundice in Cattle and Horses—Jannemange—Javelle, Eau de—Jellies—Jesuit's Drops—Jets of Fire—Jeweller's Rouge—Jordan's Balm of Rakasiri—Jesse's Purified Opium—Julin's Aquafortis—Juniper Berries, Decoction, Infusion, Extract, Oil, and Spirit of—Jujube Paste—Kali Preparatum—Keene's Marble Cement—Kemp's White.

No. 26. Kennedy's Corn Plaster—Kennett Ale—Kermes Lozenges and Minerals—Kersey's Pills—Kid Glove Cleaner—Kidder's Sweet Sauce and Savoury Spice—King's Cordial and Yellow—Kino Imitative and Powder—Kirkland's Neutral Cerate—Kirschwasser—Kitchen Pepper—Kitchiner's Essence of Herbs, Pills, Relish and Superlative Sauce—Knox's Disinfecting Powder—Kirschlin's Liquid—Koumiss—Knuckel's Phosphorus—Kusque Powder—Kustien's Metal for Tinning—Labdanum Spurious—Labels of Bottles, to preserve—Lac to Bleach, Lake, Spirit, and Tincture of—Lac-water Varnish—Lacquer for Brass, for Tin, and for Philosophical Instruments—Lacquering, to prepare Brass for, of Old Work, and Process of—Lactate of Iron Lozenges—Lactic Acid Lozenges—Lady Kent's Powder—Laennec's Sedative Draught, and Remedy for Tooth-Ache—La Fayette's Cakes—Lake Colors—Lamp Black—Langelotte's Prepared Opium—Lapis Divinus, and Medicamentous—Lard—Lardner's Prepared Charcoal—Lasteyrie's Lithography Ink—Laudanum, and of Quinres—Laughing Nuts—Laurel Ointment—Lavender Drops, Vinegar, Oil of, Water, and Ammoniacal—Laxative Medicines, Balls for Cattle—Drenches for Cattle—Lead as a Poison, in Wines—Dust and Gains Lotion of, Plaster, and Lead Tree—Loake's Pills—Leather, Dyeing of.

No. 27. Leather, to Clean, &c.—Leaves, Casting, &c.—Le Blond's Varnish for Prints—Le Bozoe's Hard Varnish—Le Dray's Marmoretum—Leechek, Application of—Lemon's Solvent for Antimony—Lemonade, &c.—Lemons to Preserve with Sugar, Biscuits, Brandy, Cakes, Cheese Curd, Concrete Oil of, Cream and Jelly, &c.—Le Mort's Ointment—Leutivie Electuary—Lenses, Cement for—Letters, to Disinfect—Lettuce, Extract of—Levure—Light Balls—Lightning, to Escape from—Lignum's Antiscorbutic Drops—Lilac, to Dye Silk—Lime, Chloride of—Lime Cylinders, for Oxy-Hydrogen Microscopes—Lime Liniment—Lime, Sulphuret of—Lime Water—Linctus, or Lohoch—Linen, to Bleach—Linctus—Linseed Oil, Purifying of, Poultice, and Tea—Lion Salve—Liqueur de Pessavin—Liquid Foul for Glass Globes, Glue, Pouce, &c. &c.

No. 28. Liquid Soap, Rouge, and True Blue—Liquorilla—Liquor Ammoniac, and Potash—Liquorice Lozenges, Extract of, Juice, and to Refine—Lisbon Diet Drink, and Wine—Litharge, and Plaster—Lithographic Chalk, Ink, Transfer Ink, Transfer Paper—Litmus, and Paper—Liver of Sulphur, and of Antimony—Locatelli's Balsam—Lockyer's Pills—Logwood, Extract of—Lohoch—London's Patent Solid Salt—London Ale—Lord Mayor's Cake—Lotion—Lovage Cordial—Lowitz's Acetic Acid—Lozenges—Lucifer Matches—Ludolph's Magistery of Opium—Lugol's Solution of Iodine—Lumbago—Lunar Cauter—Landyfoot's Snuff—Luting for Bottles—Lutes for Joining Apparatus—Lymington Salt—Lyach's Embrocation—Macaroons—Macaron, Creme de—Macaroni—Mace Ointment—Macquer's Acid Soap, Arsenical Salt—Madden's Vegetable Essence—Madder Lake, and Red to Dye—Madeira, British—Madeira, to fine—Maggots in Sheep—Magnes Arsenicalis—Magnesian Drink—Magnesia Lozenges, Mixture of, Water—Magnets, Artificial.

No. 29. Magnets, to preserve—Mahogany-colored Cement, Imitation of, Stains, Varnish—Mahomed's Electuary—Mallan's Succedaneum—Malmsey, British—Malt, Extract of, Patent, Poultice, to Make, Vinegar, to determine the Qualities of—Maltha, or Greek Mastich—Mange, Remedies for—Manheim Gold—Manna Linctus and Lozenges—Maple, to Imitate—Marsachino de Lara, French—Marble, Imitative, to Stain, to Clean—Marbled Soap Balls—Marbling the Edges of Books, the Covers of Books—Marchale, Eau de—Marchal Hair Powder, and Pomatum—Marine Glue and Soap—Marking Ink for Linen—Marking Linen, New mode of—Marlborough Cakes—Marmalade—Marriott's Dry Vomit—Marsden's Anti-Scorbutic Drops—Marseilles Vinegar—Marshall's Mixed Oils, and Cerate—Marsh-Mallows, Decoction of, Fomentation, Lozenges, Paste, and Syrup of—Martin's Varnish—Masticot—Mastic Gullipot Varnish, Mortar—Mastic Varnish Compound and Camphorated—Masticatories—Mathieu's Vermifuge—Matthews' Injection for Piles—Matthews' Pills—Mauger's Varnish—Mead.

No. 30. Mead Wine—Measles, &c.—Mecca, Balm of—Merchi's Razor Paste—Medallions, &c.—Megilph—Melons, to preserve—Mercurial Balls for Horses, &c.—Mercury, Honey of, to Purify—Merangues—Metallic Paper—Metals, Cement for—Metgoric Iron—Metheglin—Mezereon Ointment—Microscope—Microscopic Objects—Mildew in Wheat, &c.—Military Fever—Milk, &c.—Mille Fleurs, Eau de, Ices—Mince Cake, &c.—Minderrus, Spirit of—Mineral Chameleon, Marmoretum, &c.

No. 31. Minium and Mineral Orange—Mint, Infusion of, Mint Water—Mixed Fruit Wine—Mixed Oils—Mock Gold—Modelling Wax—Motte Metallique—Mole, to Disperse—Monicon, or Damonicon—Montpellier Yellow—Mordants for Dyeing—Morella Cherry Syrup, and Wine—Morocco Leather—Morphia, Syrup of—Morison's Pills—Mortar, to Make—Morveng's Preservative L'hal, White—Mosaic Gold—Motte (de la) Golden Drops—Moulds, Elastic, &c.—Mountain Wine—Mouth or Indian Glue, Modelling Wax for—Muffins—Mulberry Syrup, and Wine—Mullum—Mum—Mummy Brown—Mumps—Munro's Cough Medicine—Muriatic Acid Gargle—Muscadell Wine—Mushroom Ketchup, &c.—Musk, Artificial, &c.—Mustard Electuary of, &c.—Mynsicht's Elixir of Vitriol—Myrrh, Gargle of, &c.—Myrtle Water—Nankeen Dye—Naphe, Eau de—Naples Biscuit and Yellow—Napoleon's Pills—To Preserve Objects of Natural History—Narcotics—Nectar—Neroli, Essence of, Wash Balls—Nervine Ointment—Nervous Cordial—Nettles, Sting of—Neutral Tint—Newman's Opium—Newmarket Oil—Night-Mare—Nine Oils—Nipples, Chapped, to Heal.

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No. 33. Oxley's Tincture for Tooth ache—Oxygenated Lard—Oxymel—Oyster Ketchup—Oyster-shell Powder—Paint, Flexible—Paint, to Remove the Scum of—Painter's Cream—Panada—Paper Bleaching—Paper Glazing of—Paper Paste—Paper Powder or Polishing Powder—Paper, Staining of, Yellow, Crimson, Green, Orange, Purple—Paper de Surte—Paper Maché—Paracelsus's Plaster—Parachment—Parchment Glue—Paragon Lincture—Paragon Infusion of—Parfait Amour—Paris's Test for Wine, &c.—Parisian Dentrifrice—Parisian Soft Varnish—Parker's Cement—Parchment Cakes—Parmentier's Salad Vinegar—Parmesan to Imitate—Parsnip, or Universal Cement—Parsnip Wine—Passover Cakes—Paste for Book Binders, &c.—Pastilles—Patchouli Essence of—Patent Cement—Patent Ink—Patent Mustard—Patent Yellow—Patience Confection—Pavilion Cakes—Payson's Alchyl—Payson's Blossom Syrup of—Pearl Powder—Pearl Salt Soap—Pearl Water—Pearls, Discolored to Whiten—Pears to Dry—Pears to Preserve—Pectorals—Pencil Drawings, to Preserve—Pennyroyal Essence of—Pennyroyal Water—Pepper, Electuary of—Pepper Syrup—Pepper, Lincture of—Peppermint Cordial—Peppermint Drops—Peppermint, Essence of—Peppermint Lozenges—Peppermint, Oil of—Peppermint, Spirit of—Peppermint Water—Percussion Caps, Priming for—Perfume for Scrub Boxes—Permanent White—Perpetual Ink—Perry—Persian Cream—Peruvian Balsam, Emulsion of—Peter's Pills—Pew's Cement—Powder

No. 34. Phial Glass—Phosphoric Alcohol—Phosphoric Ether—Phosphoric Oil—Phosphoric Writing—Phosphorus Bottles—Phosphuret of Sulphur—Photographic Paper—Daguerre's Receipt—Gilding Bird's Receipt—Photogenic Drawings, to make—Photogenic, Drawings, to fix—Piccolini, or Indian Purple—Picromel—Picture Frames, Gilding of—Pictures to Clean—Picture Varnish—Pierre Divine—Piles or Hemorrhoids, (Three Receipts)—Pimento Spirit or Lincture of—Pinchbeck—Pineapple Ice (Four Receipts)—Pink Sauces, Pink Dye—Pinks, Syrup of—Pin Whorls—Pistachio Cream—Pitch Ointment (Two Receipts)—Pitch Coal Black—Pitch Balls, for Electric Machines—Pique Water—Plaster of Paris, to Cast in (Two Receipts)—Plaster Casts, Polishing of, (Three Receipts)—Plaster Figures, Bronzing of—Plate Glass, Composition of (Two Receipts)—Plate Powder, (Three Receipts)—Plated Articles to Clean—Platinum, Metal Goods to—Platinum Mould or Spongy Platinum—Platinum Ointment—Pliable Varnish for Umbrellas—Plombiere Ice, or Swiss Puddings—Plunket's Ointment for Cancer—Plunket's Ointment—Plums, to Preserve—Plummer's Cement—Plummer's Pills—Plummer's Powder—Pollard Oak—Polychrestum, Lincture of—Pomandra, or Sweet Balls, (Two Receipts)—Prunium (Four Receipts)—Pomatum, Dents for, (Six Receipts)—Pongibou Snuff—Pontefract Lozenges—Pontiff's Sauce—Poplar Buds Ointment—Poppy Lozenges—Poppy Oil, to Dry, &c.

No. 35. Poppies Syrup of—Poppies, Tincture of—Porcelain, or China—Porcelain, Enamels for—Porcelain, Color for—Port Wine Lincture—Port Wine, to Preserve—Port Wine to Improve—Portable Glue—Portable Soup—Porter to Brew (Three Receipts)—Port Fire—Portland Powder for Gout—Portuguese Water—Portuguese Cake—Potters, to Preserve—Potters, Lincture of—Potters Bread—Potters Jelly—Potatoes Paste—Pot Pourri—Pots des Brins—Pounce, (Three Receipts)—Pound Cake, (Four Receipts)—Powell's Diuretic Drops—Powell's Balsam—Pradier's Plaster for Gout—Precipitate Ointment—White Red—Pichburg's Vaseline or Biscuits—Pricked British Wine, to Restore—Prince Rupert's Drops—Prince's Cordial—Printing Ink (Four Receipts)—Printing Inks Colors for, Red Blue Green, Brown, Lac, Lac Pink Orange and Black—Printers' Rollers—Printers Types—Prints, to Bleach—Prints, to Copy, (Five Receipts)—Prints, to Transfer to Wood—Prints, to Size before Coloring—Prints, Varnishes for Colored, (Three Receipts)—Pissmore Vinegar—Promethe in Light Boxes &c. &c.

No. 36. Propriety, Lixir of—Prunella Salt of—Prussian Blue, (Three Receipts)—Prussian Cakes—Prussian Green, (Two Receipts)—Prussian Acid Lotion, (Three Receipts)—Prussian Acid Mixture—Punch, (Four Receipts)—Punch a la Reine—Punch water Ice—Purgative Medicines, (Six Receipts)—Purgative Mixture—Purgative Balls for Horses, (Two Receipts)—Purl, (Two Receipts)—Purple Enamel—Purple Fire, (Four Receipts)—Purple Precipitate of Cassius—Purple Lactates—Putty for Glaziers, Flexible—Pyrola, Infusion of—Pyroligneous Acid, or Wood Vinegar—Pyrophori, (Two Receipts)—Quassia—Quassia, Extract of—Quassia, Infusion of—Queen Cake—Queen's Cordial—Queen's Metal—Queen's Yellow—Quick Match—Quicksilver Ointment, (Two Receipts)—Quills, Preparation of (Four Receipts), Dutch Method, French Method, English Method, Austrian Method—Quince Marmalade—Quince Wine—Quinine Medicines via Cerate Ipecacuanha, Lozenges Ointment, Wine, and Syrup—Quinine Sauce (Two Receipts)—Ragout, Spice—Raisin Vinegar—Raisin Wine—Raspberries, to Preserve whole—Raspberry Cordial or Brandy—Raspberry Cream—Raspberry Drops—Raspberry Ice—Raspberry Jam—Raspberry Jelly—Raspberry Paste—Raspberry Rack—Raspberry Syrup—Raspberry Vinegar Syrup (Two Receipts)—Raspberry Wine (Two Receipts)—Ratilla, Red, Dry Sharp, a Common—Ratilla Cakes—Ratilla, Lincture of &c. &c.

No. 37. Ratilla's Cough Lincture—Razor Paste—Red Chalk Crayons—Red Crockery, Glaze for Dyes—Inamel, Red Ink Lead, and Staining Glass—Red's Remedy for Flatulency—Relaxant Medicines—Regency Buns—Rembrandt's Etching Varnish—Remnet White—Resin Cerate (Yellow Basilicon)—Resin Bubbles, Reynolds's Specific for Gout, &c.—Rhatany, Lincture of—Rhatany Root, Tincture of—Rheumatism—Rhodium, Oil of—Rhubarb, to distinguish good from bad—Rhubarb Extract of—Rhubarb Infusion of—Rhubarb, Mixture—Rhubarb Pills—Rhubarb Powder—Rhubarb, Lincture of, and Rhubarb Wine—Rice Biscuits—Rice Cakes—Rice Glue—Rich Plum Cake—Rich Seed Cake—Riga Balsam—Ring Gold—Ringwood Ale—Ringworm—Rochelle Salt—Roche's Embrocation for Itching Cough—Rockets, Compositions for Filling, Rains for, Stars, Blanks, length of—Rock-work and Reservoirs, Cement for—Roman Candles, Roman Cement, &c. &c.

No. 38. Roseate Powder—Rose Cerate—Rose Salt—Rose Hair Powder—Rose Lozenges—Rose Oil for the Hair—Rose Drops—Rose Pearls—Rose Pink—Rose Syrup—Rose Water, and Rose Wine—Rose's Glaze for Ivory Ware—Roses, Conserve of, Essence of, Honey of, Infusion of, & Lincture of—Rosemary Oil of, Essence of and Water—Rosewood, to Imitate—Rouge—Rout Cakes, Biscuits—Rousseau's Drops—Rowland's Eucalydor, Macassar Oil—Royal Essence—Ruby, to Imitate—Rudius's Pills—Rue, Confection of Ointment—Rufus's Pills—Rum, Shrub—Rums—Ruspini's Tooth powder, Lincture for the Teeth—Rymer's Cardiac Tincture—Sack Wine Imitation of—Saffron Tincture of—Sage Wine—Saker's Elix—Salberg Wash—Saline Draught—Saloon—Samplure to Pickle—Sandara Varnish—Sap Green, Preparation of—Sarsaparilla, Decoction of—Savins and Sarsaparilla White, to Clean—Savory Cakes—Saxon Blue—Saxoid Hair Ointment—Scarborough Water Cakes—Scrimony, Lincture of—Scarlet to Dye Cloth—Scarlet Fever—Scintillating—Scheele's Green—Scheele's Prussian Acid—Scotch Ale &c.

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No. 39. Scotch Buns, Cream, Marmalade, Salt, Seed Cakes, Short Bread—Scott's Pills—Scouring Drops—Scrophula—Scrophularia Ointment—Scudamore's Gout Lotion—Sculptors' Models, Composition for—Scurvy-Grass, Conserve of, Spirit of—Seal Engravers' Cement—Sealing Wax—Seals, to take Wax Impressions from—Sea Sickness—Sedatives—Sedative Mixture—Seed Biscuits—Seeds, Packing Garden—Seidlitz Powders, Water—Seltzer Water—Selway's Essence of Senna—Semolina—Senega, Infusion of—Senna, Electuary of—Senna, Infusion of, Simple, Compound, and Tartarized—Senna Mixture, (Black Draught)—Senna Powder, (Batley's Green)—Senna, Tincture of, Compound—Sepia—Serpentary, Infusion of—Serpentary, Tincture of—Shaving Oil—Shaving Paste—Sheep-skin Rugs—Sheldrake's Oil—Shells, Mending and Cleaning of—Shorbet—Sherry to to Fine a Butt of—Sherry, to Improve—Ship Biscuits—Shoemakers' Black—Short Bread—Shot Metal—Shrewsbury Cakes—Shrub—Silk, Bleaching of—Silk, to Clean—Silk, to take Stains from—Silkworm Gut—Sillabub—Silver Coin of Britain—Silver Frosted or Matt—Silver Tree, to prepare—Silvering Copper Ingots—Silvering Powder—Simple Cerate—Simple Ointment—Singleton's Golden Ointment—Size, (Soft Glue)—Size for Artists—Skeletons, preparation of—Sloes, Conserve of—Slow Match—Small-pox, &c. &c.

No. 40. Smellome's Eye Ointment—Smith's Solder for Tin—Smoke, Essence of—Smut in Wheat, to prevent—Soap Cerate, Fuena or Injection, Essence of, Linctus, Liniment, Liquid—Soda Cakes, Lozenges, Powders, Water in Bottles—Soft Toilet Soaps—Solders, viz. Common or Timman's, Soft, for Steel Joints, Silver for Jewellers, Silver for Plating, Gold, Plumber's, Glazier's, Pewterer's, Hard, Fine, Fusible—Brass Solder for Iron, Copper-smiths, &c.—Solomon's Balm of Gilead—Sore Throat (Seven Receipts, Common, Putrid, Inflammatory, Ulcerated, Gargle, &c.)—Soy, English—Spear-mint, Essence of—Specula Metal—Speelman's Pills—Spermaceti, to Refine—Spermaceti Cerate or Ointment, (Two Receipts)—Spermaceti Linctus—Spielmann's Eye Ointment—Spice, Oil of, Imitative—Spilsbury's Anti Scorbatic Drops—Spiral Varnish—Spirituus Lotion—Spitting of Blood, to Prevent—Sponge Bleaching of—Sponge Biscuits—Sponge Cake—Sponge Lozenges—Sportsman's Cordial—Sprains—Sprats, Essence of—Spruce Beer—Spruce Beer Powders—Spruce, Essence of—Squilla or Serpents—Squill Mixture—Squill Pills—Squilla Conserve of—Squilla, Honey of—Squilla, Linctus of—Squilla, Oxy-mel of—Squilla, Syrup of—Squilla, Tincture of—Squilla, Vinegar of—Squire's Elixir—Standard Measures, Alloy for—Starch, sugar from—Starch Lozenges—Starch Manufacture of—Starkey's Pills—Starkey's Soap—Stavesacre Ointment—Steel Lozenges—Steel and Platinum, Alloy for—Steel to Color Blue—Steel, to distinguish from Iron—Steel, to Gild—Steel Goods, to preserve from Rust, &c. &c.

No. 41. Steel Mixture, (Three Receipts)—Steen's Opodeldoc—Steinacher's Nitric Acid—Stephens's Remedy for the Stone—Stereotype Plates, Alloy for—Sterry's Plaster—Stimulant Faena—Stimulant Liniment—Stimulant Mixture—Stimulant Plaster—Stoerck's Pills—Stomachic Draught—Stomachic Electuary—Stomachic Elixir—Stomachic Tincture—Stomachic Wine—Stopping-out Varnish—Storax Pills—Storey's Worm Cake—Storm Glass for foretelling the Weather—Stoughton's Elixir—Strains, Embrocation for—Stramonium Linctus of—Stramonium Ointment—Stranguary, Treatment of—Strawberry Jam—Strawberry Wine—Straw Bleaching—Struve's Lotion for Hooping Cough—Strychnine Mixture—Strychnine Pills—Strychnine Spirit of—Styptica—Styes in the Eye-lids, Treatment of—St. Yve's Eye Ointment—Succedaneum, Mineral—Sugar to Holl and Clarify—Sugar Candy—Sugar Rock—Sugar Vinegar—Sulphate of Zinc Ointment—Sulphur, Balsam of—Sulphur Bleaching by—Sulphur Coins, to make—Sulphur, Electuary of, Simple, and Compound—Sulphur Lozenges—Sulphur, Milk of—Sulphur Moulds for Medallions, &c.—Sulphur Ointment—Sulphur, Precipitated Milk of—Sulphur Seals, Medals, Coins, &c.—Sulphur, Tincture of—Sulphur, to obtain Pure—Sulphuret of Mercury Cerate—Sulphuric Acid Ointment—Suppository, Purgative, Sedative and for Worms—Swinton's Daffy's Elixir—Sydenham's Lenitive—Sympathetic Inks, viz. Black, (Two), Brown, Blue, Yellow, Red—Syrian Gardet, to Imitate—Syrup Cream, or Cream Syrup—Table Ale—

Table Beer—Tain, Eau de, (Thyme Water)—Talc Water—Talc, Oil of—Tamarinds, Conserve of—Tamarinds and Senn—Tannin Ointment—Tar Ointment—Tar Varnish—Tar Water—Tartar Emetic—Tartar Emetic Mixture—Tartar Soluble—Tartar, Soluble Cream of—Taylor's Defensor, &c. &c.

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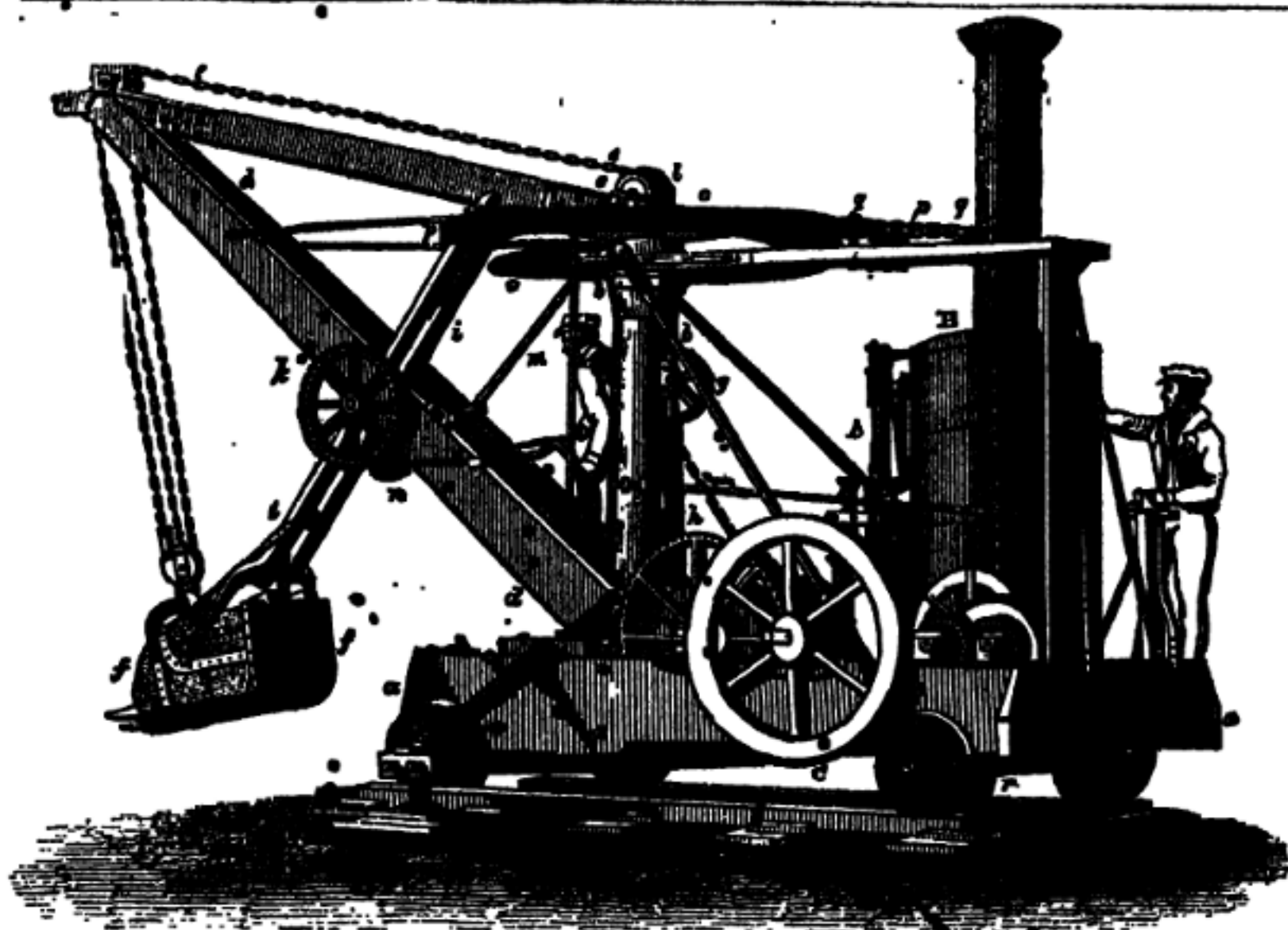
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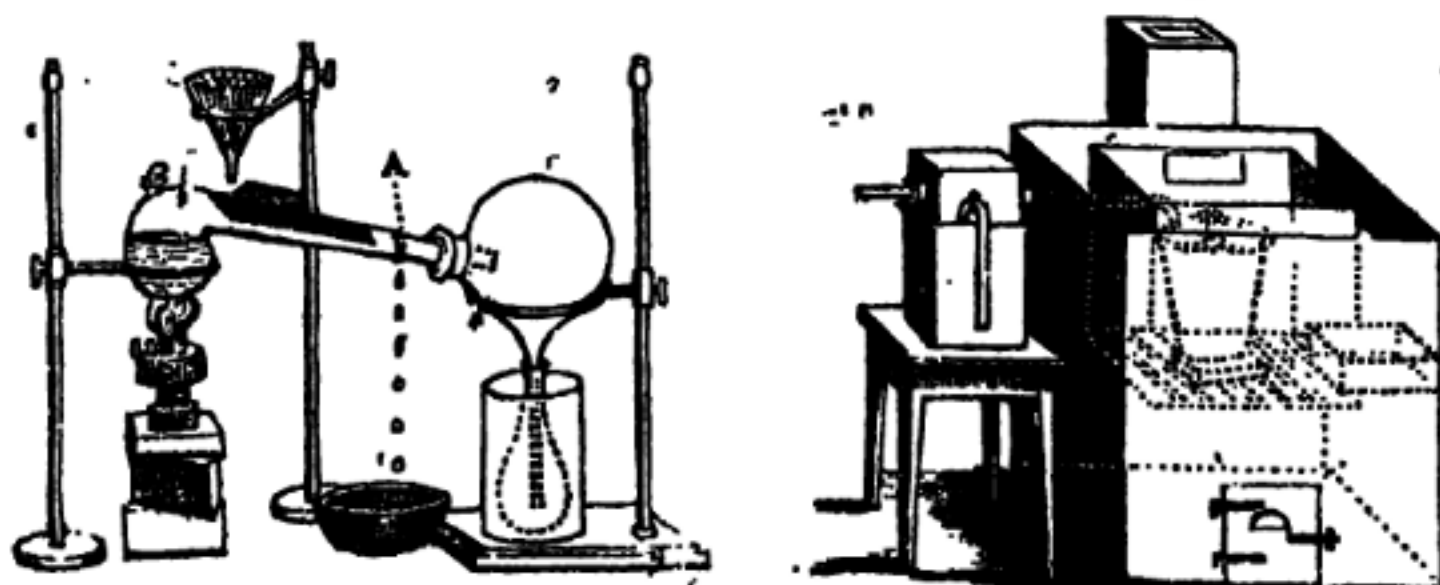
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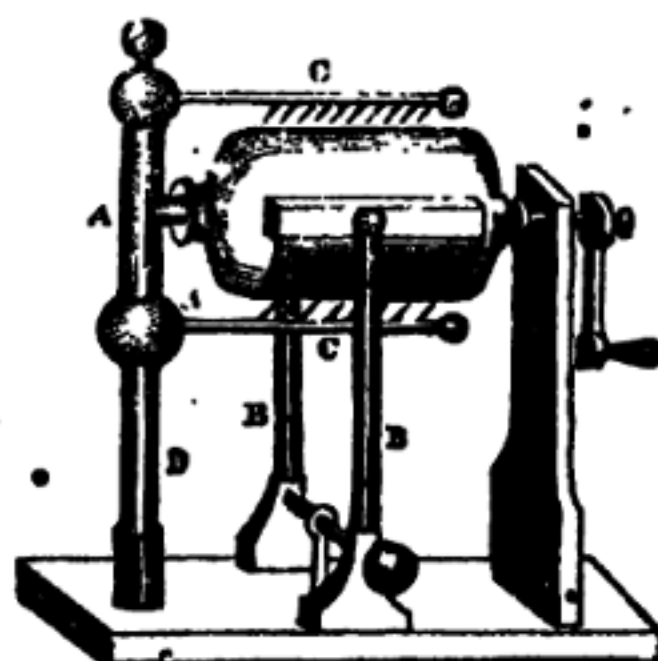
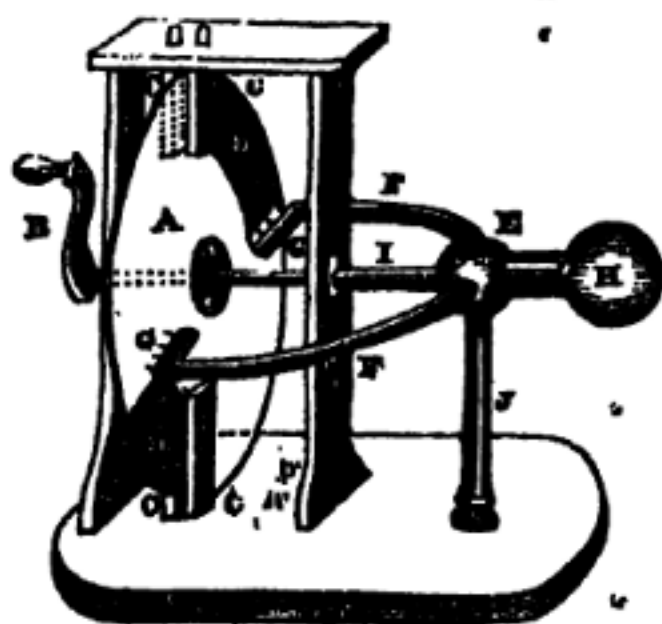
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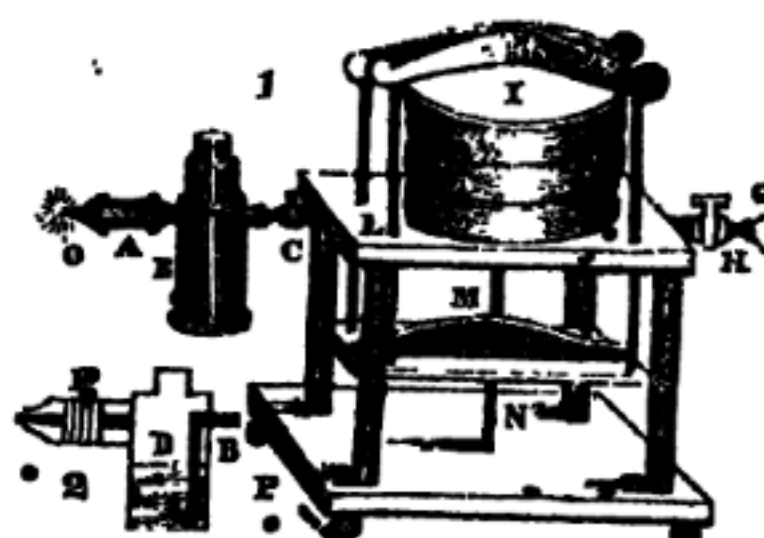
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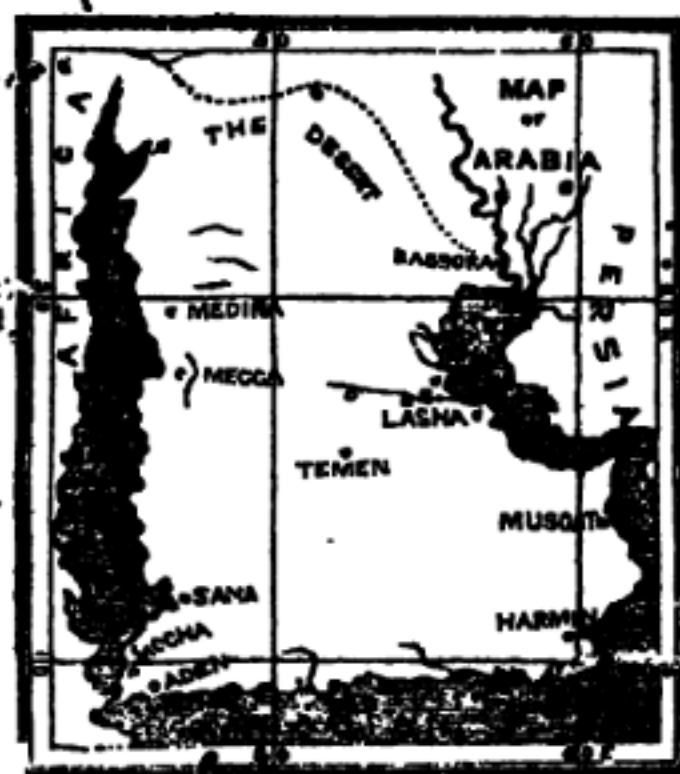
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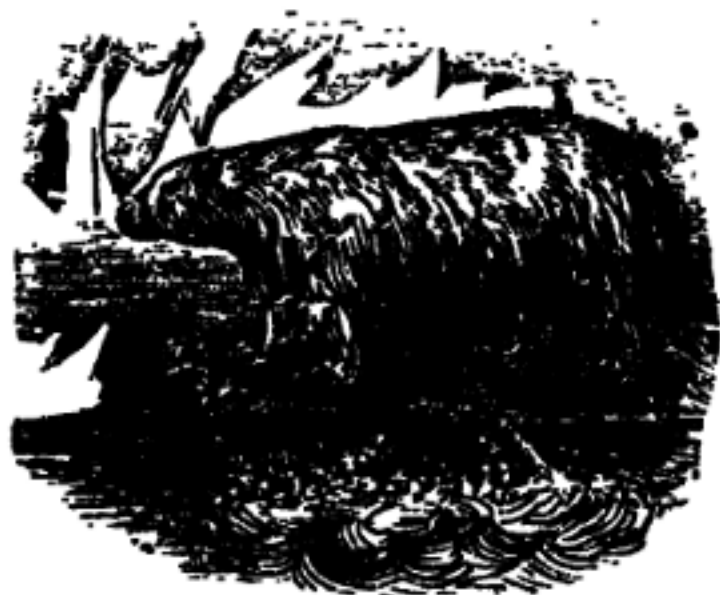
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